# ENGINEERING AND MINING JOURNAL

1866

DIAMOND JUBILEE NUMBER

1941

*75 Years of Service to the Mining Industry*

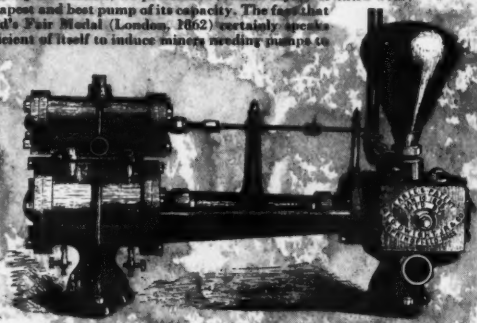
AUGUST, 1941

PART 1

# A Century of Progres
## *in the Pumping of*
# Abrasive Materials
# MODERN

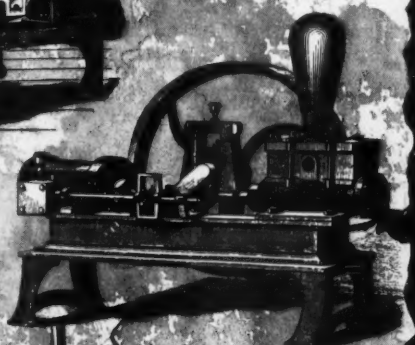
Patented Andrews Centrifugal Pump

EXCERPT from American Journal of Mining, September 1, 1866 . . . Centrifugal Pumps. Continuing our series, we come to 'Andrews' Patent Anti-Friction Centrifugal Pump,' an engraving of which will be observed on this page. We are informed that many years ago the inventor of this pump, while saving wrecked vessels and goods, saw that none of the pumps then in use was adequate to the business. With this idea he went to work, and invented what is known as the 'Gwynne Pump,' which he used in his business in 1844, and patented in 1846. Continuing the study of his subject, he at last succeeded in bringing the centrifugal pump to its present improved condition. The manufacturers—Wm. D. Andrews and Bros. of 414 Water Street, New York—claim for it that it saves power, being nearly frictionless, moving the water in gentle curves instead of at right angles, as in other pumps; that with no rubbing surfaces to wear out, no valves to get out of order, and no parts [illegible] it costs nothing for repairs, and is so simple that any person can run it; that it will not lose its charge; that it pumps mud, gravel, sand, corn, coal, sawdark, paper-pulp, and [illegible] else that can be pumped—barring individuals, we presume—without injury or extra wear; and, in short, that it is the cheapest and best pump of its capacity. The fact that this pump received the World's Fair Medal (London, 1862) certainly speaks much in its behalf, and is sufficient of itself to induce miners needing pumps to inspect this one at the World's. *Foregoing applies to the Andrews' Pump, pictured above, but all of these pumps were modern, when described in the American Journal of Mining, during its first year [illegible] 1866.*



Earle's Patent Steam Pump

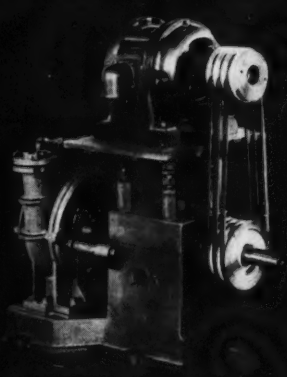
Woodward's Patent Duplex Steam Pump and Fire Engine



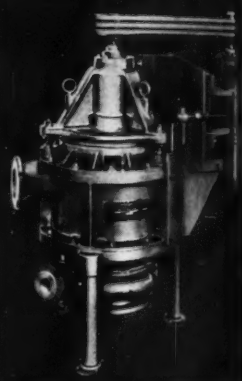
Hardrick's Patent Double-Acting Steam Pump and Fire Engine

Clayton's Steam Pump, Hand Pump and Steam Engine

## HYDROSEAL SAND SLURRY PUMP



## PACKLESS ACID PUMP



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ENGINEERING & MINING JOURNAL

H. C. PARMELEE
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Volume 142 AUGUST, 1941 Number 8

# Seventy-Five Years of Virile Journalism

INDUSTRIAL JOURNALISM in the United States is contemporaneous, broadly speaking, with American industry. Both date their rapid growth and expansion from the years immediately following the Civil War, when the economy of the United States was shifting from agriculture to manufacture. Three-quarters of a century, therefore, mark the span of this era in American life.

But within that period few industrial journals have seen seventy-five years of continuous publication. Many started bravely but fell by the wayside; others lost their identity through merger and consolidation. Only a minority had the stamina and virility to survive through good times and bad, booms and depressions, peace and war, proving their essential worth and earning their livelihood through service.

So, a year or more ago, as *Engineering and Mining Journal* approached its seventy-fifth birthday, it seemed to us an occasion for appropriate celebration. Diamond Jubilees are few enough in human experience, and ought not to be passed without recognition. In our case it seemed no small achievement to have published this *Journal* regularly and without interruption since March 31, 1866.

But how to celebrate the event? That was the puzzling question confronting the editorial staff. The very magnitude and diversity of the mining industry presented an obstacle to journalistic treatment within the compass of a monthly magazine. Numerous suggestions were considered and abandoned, and several plans were roughed out and discarded. Finally, a workable and, we hope, useful idea was adopted, which is presented in succeeding pages.

From the beginning we resisted the thought of publishing long, dry historical reviews of the past seventy-five years in mining and metallurgy. Nor were we content to invite bouquets of friendly commendation, or indulge in self-conceit. Rather we would try to make a constructive contribution to the progress of the industry and profession with which the *Journal* had so long been identified.

THE THEME of this issue, therefore, is embodied in the phrase repeatedly used throughout, "Vignettes of the Future." One feature is a group of vignettes of things to come in mining and metallurgy, in which the authors have indulged in speculation on trends in technology, and have modestly discussed probable future developments as they see them. Historical aspects of their subjects are duly subordinated.

Another feature of the issue consists of a series of thumbnail sketches of the mineral resources of the Western Hemisphere. Contributed by authorities in countries extending from Pole to Pole, the information thus brought together has timely significance for the future of the Americas. *Engineering and Mining Journal* and its readers are indebted to more than threescore authors who have generously given of their time and talents to make this Diamond Jubilee number useful to the mining industry.

Of the editors who have guided the fortunes of *E. & M. J.* we have something to say on pages 160 and 161. No attempt is made at biographical completeness, but we have tried to indicate the outstanding contribution that each made to the *Journal*. Almost without exception these men put their stamp on *E. & M. J.*, directed its editorial content to the needs of the times, and maintained its reputation for reliability and integrity. On this point of editorial excellence

Mr. James H. McGraw, founder of the McGraw-Hill Publishing Company and honorary chairman of its Board of Directors, speaks from the experience of a lifetime as a publisher.

"The record of *Engineering and Mining Journal,*" he writes, "is the best possible tribute to the high editorial ideals and sound publishing policies that charted its course for seventy-five years. Something more than mere lapse of time must be invoked to account for the continuous publication of an industrial journal for three-quarters of a century. In my judgment the key to this achievement is to be found in the virile policies of a succession of editors who, in addition to their distinction among the mining fraternity, always sensed the necessity for integrity, independence, and service in the editorial conduct of the *Journal.* Little as we know of the first editor—George Francis Dawson—his salutatory is enough to give him distinction in industrial journalism. A model of modest determination in its time, it is yet modern enough in its concept of the editor's obligation to his industry to have been written in 1941 instead of 1866. His successors without exception maintained ideals and policies that easily account for the *Journal's* remarkable acceptance throughout the mining industry, and for its editorial vigor after seventy-five years of service. On no other ground can the record be explained."

WITH the flexibility and adaptability that is characteristic of an industrial publication, *Engineering and Mining Journal* has evolved through several stages of development. Originally established as the *American Journal of Mining* and published under that name from March 31, 1866, to June 29, 1869, the *Journal* was essentially a mining newspaper. In the first issue, which we reproduce as Part 2 of this Diamond Jubilee number, the reader will find a surprising wealth of news from the mining districts of that time. Indeed, he may have some difficulty in identifying such then well-known places as New Granada.

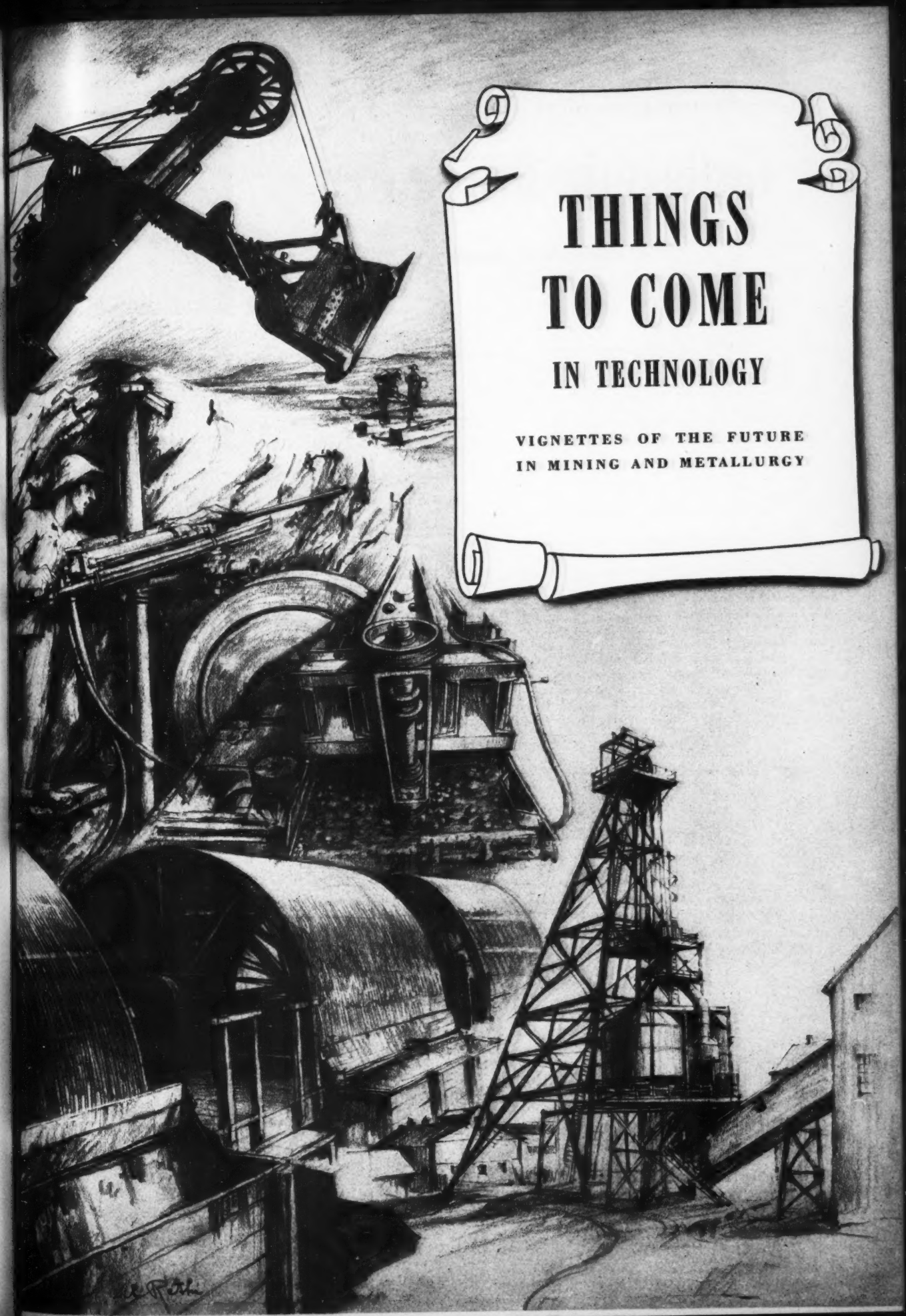
Early in its history, however, the *Journal* began to publish technologic and economic material, and gradually built its reputation for authority and reliability in those aspects of the mining industry. The *Journal's* present authority in nonferrous metal prices—an authority unique in commodity-price reporting—had its foundation during the editorship of Rothwell and was emphasized and firmly established by Ingalls. Needless to say, so precious a heritage is jealously guarded, with the result that "*E. & M. J.* quotations" are standard in governmental and industrial circles.

There was a militant note in the early editorial activities of the *Journal* that was highly beneficial to the mining industry. Realizing that the business of mining was easily subject to abuse by crooked promoters, with consequent financial loss to gullible investors, the *Journal* early sponsored the American Bureau of Mines, a volunteer body composed of honest and reliable mining engineers, to scrutinize mine promotions and warn the public against swindlers.

The interests of the growing profession of mining engineering were early recognized by *E. & M. J.*, with the result that the *Journal* cradled the infant American Institute of Mining Engineers and helped raise it to lusty independence. It was during Raymond's editorship that Rothwell urged the formation of a professional society, which was organized in 1871. For some years *E. & M. J.* was the official organ of the Institute. Raymond and Rothwell, both editors of the *Journal,* served the Institute as president, and Raymond was subsequently secretary for many years.

These are merely a few examples of the *Journal's* leadership in its early days—striking evidence that a virile industrial journal is not something apart from the industry it serves, but a part of it. Inspiration is drawn by the present editors from these early incidents, because they show with what understanding the *Journal* met the problems of the day, and how devotedly it served its industry. Today's problems are different, and perhaps more complex, but they are approached in the same spirit of service that animated the *Journal* and its editors of an earlier day. It is in this spirit, also, that we depart from custom and tradition in anniversary numbers by offering our readers "Vignettes of the Future."

IN CLOSING, we extend friendly greetings to the great mining fraternity—prospectors, engineers, operators, technologists, inventors, manufacturers—whose timely contributions have made the industry great, and to whom it must continue to look for progress. We salute also that small but distinguished body, the Fifty-Year Club, men who have been readers of *Engineering and Mining Journal* for fifty years or more. Among them, we have recently been in touch with Walter H. Aldridge, George B. Conway, Arthur S. Dwight, Karl Eilers, William H. Hampton, H. E. T. Haultain, George A. Marsh, Edward P. Mathewson, George A. Packard, Edward W. Parker, Frederick F. Sharpless, Arthur L. Walker, H. A. Wheeler, C. Q. Payne, W. F. Staunton, and Pope Yeatman. To one and all we express our warm regards and appreciation.



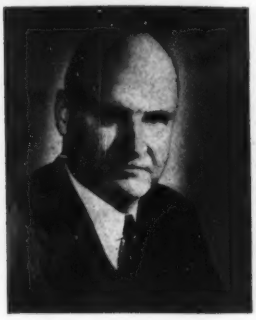
# THINGS TO COME

## IN TECHNOLOGY

VIGNETTES OF THE FUTURE
IN MINING AND METALLURGY

VIGNETTES OF THE FUTURE

# Geology in Ore Search



**GEORGE M. FOWLER**
*Consulting Geologist*
*Joplin, Mo.*

MINING GEOLOGY is a progressive study which requires keen observation and analysis and an understanding of the fundamentals of chemistry, mechanics, and physics. Its development during the past fifty years has been very rapid and with an ever-increasing impetus. To date some progress in the knowledge of ore deposits has been made, but much greater efforts are necessary if the present ore reserves are to be maintained.

The day of the simple and easy discovery of a mine is nearly gone. Many of the important mines now being worked throughout the world were found centuries ago. Few of the past discoveries were made by technically trained men.

Those engaged in the study of ore deposits have long recognized their close ralationship to structural deformation. The structural pattern within many mining districts has been determined with sufficient accuracy to delineate important orebodies therein. A little progress has been made in determining the reasons for the localization of mining districts as a unit in certain areas, but much additional factual evidence is necessary. Practically nothing is known regarding the structural relationship that may exist between two or more mining regions.

Zones of intense deformation, the ore reservoirs in the mining districts in many cases, constitute only minute areas of any region. There are numerous examples of mining districts which illustrate these conditions, as: Butte, Montana; Bingham Canyon, Park City, Tintic, Utah; Bisbee, Ajo, Miami, Morenci, Arizona; the Oklahoma-Kansas zinc-lead field; and the southeast Missouri lead district.

The chief problem in seeking new mining districts is to locate and delineate the remaining areas in which ore may be found. Few of these will show many surface manifestations and some will be entirely concealed by formations from a few feet to thousands of feet in thickness.

Anyone who would seek potential ore deposits successfully must rely largely on the work of highly trained technicians. What chance has a prospector under existing conditions? The problem has become so complicated that its solution requires the combined efforts of geologists, physicists, chemists, and others, all proficient in the nature and character of ore deposits. Their work may be placed in two general fields:

First is the work of locating new orebodies in known mining districts. Competent workers in many countries have for years successfully made new discoveries in established mining districts. They are gradually improving their technique by correlating and appraising the knowledge gained by the profession as a whole.

Important new orebodies will be discovered in nearly every existing mining district. Only a few districts, however, have been explored to their lateral and vertical limits.

Other geologists have emphasized the possibility of ore deposits under the so-called "porphyry coppers" of the Western States and the need for a painstaking study and record of the factual geology regarding them as the present mining operations progress.

Much important evidence regarding ore deposits is being lost forever because some of those in charge of developments neglect to record all the factual evidence obtainable during mining operations. This work should be done and the data placed in depositories for future reference.

The second field is that of locating new mines and mining districts in other regions. In every region that has been studied, much of it has been eliminated as barren, but the remainder warrants further appraisal by a combination of all known methods and other methods that may be developed as the work progresses. There is little opportunity here for people who rely on "hunches" or haste.

Our successors in the quest for ore deposits will be more adequately prepared, keener observers, and much better equipped investigators. Their work will combine the efforts of the geologists, geophysicists, geochemists, and others who have a knowledge of ore deposits, together with the equipment that may be developed for their use. Their efforts will be of lasting benefit because such efforts will extend the life of the mining industry. Their opportunities will be limited only by their ability to understand and solve their problems.

## IN RETROSPECT

**Mining was held in disrepute by many of the ancients. Their quaint views regarding the origin of ores and metals were based almost entirely on philosophical speculation. Early in the fifteenth century, old ideas regarding properties of minerals were gradually discarded as the minerals became objects of investigation and research. Georg Agricola (1494-1555), father of mineralogy, was probably the first to observe that "veins have their run and their rules."**

***1809*** **William Maclure (1763-1840), father of American geology, completed the first map and memoir of the geology of the country after researches in every State and territory.**

***1815*** **William Smith (1769-1839), of England, laid the foundation of stratigraphic geology, one of the essentials in the search for many mineral deposits.**

***1886*** **S. F. Emmons (1849-1911) noted the relationship of structure to ore deposition in his report on the Leadville district.**

***About 1900*** **Waldemar Lindgren (1860-1939) and many contemporaries applied and augmented the knowledge learned from their predecessors and established the study of mineral deposits on a firm basis.**

VIGNETTES OF THE FUTURE

# Mining Geophysics

**CARL A. HEILAND**
*Professor of Geophysics*
*Colorado School of Mines*
*Golden, Colorado*

THE BIRTH of mining geophysics dates back to the beginning of the 17th century. For about 300 years this branch of science was virtually limited to magnetic prospecting. Its application was highly developed in Sweden and gradually spread to England and the United States.

Essentially, the history of mining geophysics is that of magnetic and electrical prospecting. Only where mineral deposits were sedimentary, have seismic methods been applied commercially. Ever since the days of Eötvös, there have been applications of the torsion balance to mining problems, not so much for reconnaissance as for detail. Such work has recently been supplemented by surveys with the gravimeter, first used in 1937.

Those who have watched the progress of geophysical exploration have often wondered why the mining industry has not utilized its possibilities as extensively as the oil industry. A number of factors are responsible: The use of geophysics in mining rarely yields data geologically as unique as in oil exploration, inasmuch as the use of the reflection method is precluded by the complex and heterogeneous nature of the rocks. In mining we deal with many different minerals, whereas in oil we deal essentially with one, and one of simpler structural association. The dimension of the average orebody being less than that of the average oil structure, a closer spacing of stations is required, making extensive reconnaissance costly if not impossible. Rugged topography often causes additional interference and makes transportation difficult.

The years following the introduction of geophysical methods into this country were characterized by overconfidence, and geophysicists still hear of the failures that happened then. Now, there is too much pessimism, in view of the improvement in equipment and technique. It is scarcely realized that the geophysicist, to give his best under difficult conditions, needs all the help the mine operator can give.

Cost in terms of actual or anticipated discoveries is of paramount importance. The value of geophysically discovered oil exceeds the cost of the geophysical work in a ratio of about 10 to 1. This is, in the final analysis, due to the large size of the average reservoir. On account of the smaller dimensions of the non-structural orebody, such a favorable ratio cannot be expected in mining. In oil exploration, a certain standardization of procedure has reduced the relative cost of geophysical work. Such standardization cannot be expected in mining for some time, due to the extreme variations in types of minerals, mineral associations, and stratigraphic and structural conditions. On many prospects the geophysicist still has to experiment to determine the best approach. That there will be some failures must be anticipated, these owing to a lack of sufficient ore of commercial grade in the deposits located. The oil industry has learned to accept such failures as inevitable and not to blame the geophysicist solely. In mining, however, he often gets more than his just share. If he finds no indications at all, he is likewise criticized. At the same time, he should be prepared to state frankly what he can do and what he cannot do, and should refrain from overoptimism. Above all, he should analyze the geologic situation or get a geologist to do it.

In the future, mining geophysics will probably be most useful in connection with systematic surveys for delineating structural relationships. A notable beginning has been made with the dip needle in the Lake Superior region and the magnetometer on the Witwatersrand. In such cases, geophysics need not be confined to magnetic and electrical surveys; conditions permitting, additional information may be anticipated from use of gravimetric and seismic methods.

With respect to the non-structural type of mineral deposit, a bright future lies ahead; the field includes the revival of abandoned mines and the extension of present workings. Here, the geophysicist has much more to work with than when exploring virgin territory. Much useful information can also be obtained by electro-logging exploratory drill holes.

In the large field of engineering geophysics numerous problems can be attacked with existing methods; for instance, the determination of overburden thickness, tunnel investigations, location of faults and water seeps, cementation problems, and the study of rock bursts, roof subsidence, and mine caving.

## IN RETROSPECT

**1640** Swedish document refers to use of the compass in magnetic prospecting.

**1830** Robert Fox establishes and investigates spontaneous polarization of orebodies in Cornwall.

**1873-1904** Period of fundamental investigations and perfection of magnetic instruments.

**1891-1910** Commercial interest in electrical prospecting begins. Various patents taken out. Radio methods developed.

**1912-13** Searle studies four-terminal resistivity system. Bergstrom invents A.C. equipotential and Schlumberger D.C. equipotential line methods.

**1915** Schmidt builds vertical magnetometer; Wenner and Schlumberger perfect four-terminal resistivity system.

**1921** Self-potential method introduced in United States. Inductive electric method developed in Sweden and Germany.

**1926** Electrical methods introduced on larger scale.

**1930-33** Magnetometer surveys on Witwatersrand successful.

VIGNETTES OF THE FUTURE

# Compressed Air Drilling

**C. W. NICOLSON**
*Manager Beck Mining Company*
*Miami, Okla.*

DEVELOPMENTS OF THE PAST DECADE in compressed air drilling have been mainly improvements in the design of drills and compressors rather than any radical changes or inventions.

Drilling with compressed air is recognized as an inefficient use of power, but as a mode of power transmission and utilization the factors of convenience and expediency have offset the low degree of efficiency. Many attempts have been made to apply electric power directly to the drills, but except in the use of electric auger drills for soft ores there has been no indication of success, and there is no reason to expect any in the near future.

The use of light diamond core-drills for drilling blasting holes underground should be noted. Where conditions are favorable for large blasts, the use of such core-drills will probably increase, but it seems doubtful whether they can supplant compressed-air drills for ordinary stoping or drifting.

Another attempt to avoid the use of compressed-air drills has been by melting a hole in the rock by the application of intense heat. Accurate data are lacking as to the results of such experiments, but whether they will be successful except under most unusual conditions seem doubtful. For the immediate future it seems likely that we shall see no marked change in the system of drilling as we know it now.

## IN RETROSPECT

**1851** J. W. Fowle patented percussion drill; used in Mont Cenis tunnel, Alps, 1861, with first air-compressor plant.

**1866** Charles Burleigh's piston rock drill used in Hoosac tunnel, Massachusetts. Probably first successful use of compressed-air rock drills in U.S.A.

**1871** Simon Ingersoll's piston drill used in contract work in New York City. Improvements and modifications contributed by Henry C. Sergeant.

**1878** First important use of compressed-air drills in mines at Calumet & Hecla, Michigan, where the Rand drill was introduced.

**1890** About this time C. H. Shaw introduced hammer drill; steel loosely held in chuck; air-cylinder feed; limited to overhead drilling.

**1897** J. George Leyner patented hammer drill using hollow drill steel to pass air and water into the drill hole.

**1925** Interest shown in detachable bits. Continuous experimentation and improvement have resulted in general adoption.

The development during the last few years of power feeds in place of the hand-cranked feed-screws for drifters has increased drilling speeds materially. One would expect to see further improvement in the design of such feeds and a much more general use of them in mines.

The widespread use of detachable bits has been one of the most striking developments in recent years. First attempts to use them were prompted by the high cost of moving large quantities of drill steel in and out of deep mines each day. As the use of such bits increased it was realized that there were other, and perhaps more important, reasons for their use. First, the bit could be made of a steel better adapted for the work of drilling; and second, bits could be made in forms which would have been difficult to forge on a sharpener but which were much better adapted for the work they were to do. For years the use of the four-point cross-bit, with 5-deg. and 14-deg. tapers, had been almost universal, whether the rock was brittle or tough, abrasive or non-abrasive. Experience with detachable bits soon led to the realization that for each kind of rock there is a design of bit more suitable than any other, and that in very few cases is this the old tapered four-point cross-bit. Most bits now have zero taper and the bits are long and of minimum diameter for non-abrasive rocks, and short and of greater diameter for abrasive rocks, where sharpness of cutting edge is of less importance than the avoidance of rapid loss of gage. Three-point bits are displacing four-pointed ones for some rocks, and new designs are constantly appearing. We may confidently look forward to better drilling practice as more and more mines adopt detachable bits and perfect designs suitable to each different rock condition.

In the days of the universal use of forged bits, drill steel had to serve three purposes: It withstood the impact of the drill hammer, it transmitted the force of the drill hammer to the bit, and its upset and forged end formed the bit. Choice of steel was, therefore, a compromise between one to form a satisfactory bit and one to withstand impact and vibration. With the use of detachable bits such a compromise is no longer justified. Some steels are already appearing which are much more satisfactory, and some alloy steels are on the market which will withstand impact and vibration for two or three times as long as the old steel. Unfortunately lugs and collars cannot be forged on these alloy steels and at present they can be used only in drills with anvil-block chucks. There is reason to believe that this difficulty will soon be overcome.

Looking into the not-too-distant future—and no one can see very far in this day and age—one would expect to see a marked improvement in the quality of drill steel; an almost universal adoption of the detachable bit, with many new designs appearing; a gradual, but slight, increase in the efficiency of compressors and drills; and the occasional use, under conditions which are particularly favorable, of methods for boring holes other than by compressed-air drilling.

VIGNETTES OF THE FUTURE

# Diamond Drilling

**R. D. LONGYEAR**
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*Minneapolis, Minn.*

ALL MACHINE TECHNOLOGY is in a state of flux. The diamond drill is no exception. To forecast future development is hazardous, but the following trends seem to be indicated:

1. Because of the general trend in mineral exploration towards "geological bets"—that is, towards the search for buried extension of known orebodies and districts—the diamond drill, guided by the knowledge obtained through geophysical exploration, will play an increasingly important rôle.

2. Greater attention will be paid to careful sampling, and there will develop a greater understanding of the value of the diamond drill as a means of gaining information that is strictly geological in nature without reference to ore values.

3. Directional control of drill holes will find increasing application.

4. The general design of drilling machines will undergo that type of modification popularly known as streamlining. Trailer mountings and other devices will be employed to increase their portability.

5. The mechanically driven screw-feed mechanism providing a constant rate of advance will yield place to the hydraulic feed or other type of feed that will provide constant pressure on the bit. This will provide an automatic change in the rate of advance with varying ease of penetration.

6. Inasmuch as compressed air is neither efficient nor economical as a means of transmitting power, the future trend in underground diamond drilling will be towards the increased use of electricity or some other more economical form of power.

7. The trend is definitely away from diamond bits and reaming shells set by hand on the job towards bits and reaming shells set mechanically by the manufacturer. Much improvement in the quality and performance of mechanically set bits and shells has taken place during the last few years, and further improvement can be expected over the next few years. The long-range trend will probably be towards setting bits with smaller diamonds.

8. Further standardization and interchangeability of bits, core-barrel parts, and other fittings will result in increased efficiency for the user.

9. Probably the most outstanding prospective development will be a greatly increased use of the diamond drill for drilling blast holes in mines. Experience at Noranda, at Aldermac, and at many other mines has demonstrated that in massive orebodies susceptible to attack by long holes, the diamond drill shows a marked saving in costs per ton mined over the pneumatic percussion drill. The savings lie largely in the reduction of stope development works and more effective use of explosives that thereby become possible.

Use of the diamond drill for drilling development headings will come as soon as changes in drill design permit. Long diamond-drill holes in connection with a burnt cut is on the way to adoption. Present costs of 6-ft. and 8-ft. diamond-drill holes, in very hard rock, such as at the Soudan mine, in Minnesota, are lower than percussion drill costs in the same material.

*Future Needs*—The diamond-drill industry has learned much from past experience, but many problems remain for future solution. Rule-of-thumb experience needs to be enhanced by engineering data. Research is required on:

1. The behavior of diamonds of specific sizes and shapes when drilling rocks of specific grain structure and hardness.

2. The best bit pressures and bit rotating speeds for given rock drilled with a given type of bit.

3. Horsepower requirements for specific combinations of rock type, bit, and hole depths.

4. Bit design.

5. The elimination of vibration. Penetration speeds have been markedly increased, but there has not been a proportionate decrease in the "dead-time" operations of hoisting and lowering drill rods, rechucking, adding rods, rigging up, and moving.

Drill manufacturers welcome suggestions for improvements in technical features listed in the foregoing, from mining engineers, geologists, drill runners, and all consumers.

## IN RETROSPECT

**1863** Leschot invented and used the diamond drill for the purpose of drilling blast holes in the course of driving the Mt. Cenis tunnel, in the Alps.

**1868** Marble companies in the State of Vermont made use of diamond drills for cutting blocks of marble in their quarries at approximately this time.

**1870** Bullock undertook to put down the first deep diamond-drill hole. This was in the neighborhood of Pottsville, Pa.

**1890-1910** The Mesabi Range, in the Minnesota Iron Country, and the Rand, in South Africa, were intensively explored with the diamond drill.

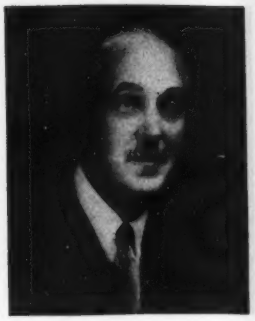
**1930** Standardization of diamond-drill fittings was adopted by the industry in the United States and Canada.

**1930-41** Marked advance was scored in drill design and operating technique. Bortz largely replaces carbon; gasoline motors replace steam engines; higher bit-rotating speeds achieved; costs per foot reduced.

**1939-41** Many mines in the Dominion of Canada introduce the diamond drill for blast holes in stopes.

VIGNETTES OF THE FUTURE

# Shaft Sinking and Tunneling



**ROBERT S. LEWIS**
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SHAFT SINKING or tunneling may be done either in the most economical way or in the least possible time. In the latter alternative economy is not considered, and men and equipment are used wherever they will give increased output or will save time, regardless of cost. In shaft sinking, mucking consumes something like half the total time. Because of the limited space it is generally done by hand, though a scraper was successfully used to load buckets at one shaft. A shoveler's efficiency falls off some 8 per cent for each foot of increased lift above 18 in. Hence, the use of loading pans has proved advantageous. Buckets of 60-cu.ft. capacity were satisfactorily tried at one mine. Operations should be synchronized to keep shovelers busy, but lost time occurs. In some round shafts, water is pumped from the bottom into a tank not far above. Bailers then hoist the water from the tank. If some analagous method of removing broken rock continuously, as by an elevator to a bin from which skips could be loaded, could be devised, mucking would be expedited. Shaft sinking is accelerated by using manifolds for air and water lines to drills, a single oiler, and a stage on which the timbermen stand. Two hoists may also be used.

Shaft sinking by boring offers advantages. Holes up to 7-ft. diameter can be bored. Core from a 10-ft. hole would weigh about 100 tons, but could be handled by a headframe like an oil derrick. Much larger holes could probably be bored, but the cost would be uneconomically great. Another plan is to sink two holes close together for balanced hoisting. Then swing the derrick boom in the other direction and bore a third hole 60 ft. away. This might answer the legal requirements for two exits. Also, a prospect borehole might be enlarged, when ore was proved, to a full-size round or rectangular shaft with little or no shoveling. A circular bucket long enough to hold 25 tons could be lowered into the hole. Benches could be drilled and blasted to enlarge the borehole, the drill holes slanting up from the hole or pointing down in the benches. A packing in the form of a heavy pneumatic tire could be placed around the outside of the bucket at the top to keep fine material out of the hole. Only enough rock to fill the bucket would be broken at one time. The hoisting cable must be strong enough to withstand the blasting.

In tunneling, it is now possible to complete four cycles of drilling, blasting, and mucking in one eight-hour shift in a tunnel 11 ft. high and 9 ft. wide, as at the Carlton tunnel. Drilling is done from a "jumbo" to save time in setting up drills. The full number of drills required can be mounted at one time. Rate of drilling is nearly proportional to the air pressure used. Increased speed of drilling was secured at the Carlton tunnel by using air at 125 lb. per square inch at the drills. The jumbo must be heavy enough to keep the drills (with automatic feed) up to their work.

Drilling speed was also materially increased by the use of detachable bits and 1¾-in. starters for 9 ft. holes, with ⅛-in. change of gage. A vertically acting cherry picker was a success. By using 6-ft. rail sections at the face, 6-in. air pipe in 60-ft. lengths, and 18-in. exhaust pipe for ventilating, no lost time was experienced when extending these items.

The efficiency of a loading machine depends largely on having a steady supply of empty cars. J. A. Garcia proposed the integrating system of loading cars. An overhead conveyor (like the Dixon conveyor) the length of several cars, receives rock from the loader and discharges it into the rear empty car. By using this system a conveyor five cars long can be made to load 31 cars before it has to shut down for a new train.

As the loading machine must usually be taken to a siding and the jumbo brought to the face, it would seem possible to have an overhead conveyor and a jumbo that could straddle the loader. After the drilling the jumbo could be moved just back of the loader, which would be brought to the face. A short, low belt conveyor, running under the jumbo, could supply the overhead conveyor from the loading machine. Thus practically no time would be lost in moving loader or jumbo. Full-size entries have been driven in coal with the McKinley entry borer. A rock borer may yet be devised to drive full-size drifts as a continuous operation.

## IN RETROSPECT

***Man has understood*** the art of excavating underground for many centuries. Temples and sepulchers were dug in hard rock as early as 1500 B.C. with hand tools at tremendous expenditures of energy. Saws of copper were set with teeth of abrasive material or were fed with emery powder. Circular holes were drilled with a tube having fixed teeth on which emery powder was sprinkled. Grooves were cut in the rocks, and blocks were broken out by wetting wooden wedges driven into these grooves. Rocks were also broken by chipping and occasionally by "fire-setting."

***The greatest tunnel*** was driven by the Roman Emperor Claudius to drain the overflow from Lake Fucinus. It was 19 ft. high, 9 ft. wide, and three miles long. It was completed in 52 A.D. after eleven years of work. Early shaft sinking was limited in depth by presence of water, lack of pumping equipment, and small hoisting capacity of the windlass. Unstable, watery ground called for special methods of shaft sinking. Piling was first used. Later came methods of boring under water, as the Kind Chaudron. Toward the end of the nineteenth century the freezing process was used, and in the twentieth century M. A. Francois introduced the cementation process.

VIGNETTES OF THE FUTURE

# Underground Loading

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SINCE HAND SHOVELING is not attractive to either mine workers or to mine operators, the trend towards mechanization should continue until, in routine operations, all hand shoveling has been supplanted. The loading practice today at mines outstanding in efficiency may become standard practice tomorrow throughout the industry. As the wage scale is raised, the advantage of the machine will increase. In deep mines, which require rapid development and a high rate of ore extraction, mechanical loading is indispensable for efficient operation. Production and speed of loading will increase through a more general use of larger cars or possibly mechanical conveyors in connection with the loading units.

Few breakdowns now occur with modern loading equipment, and maintenance charges are relatively low, yet the idle time for a loading machine on a 24-hour basis is very high because it generally works in only one or two headings and consequently loads few rounds in a single day. To overcome this, perhaps some changes in design or the use of better materials of construction may produce greater portability or may facilitate its transfer from one heading to another. Alloys of steel with the light metals have improved both surface transportation equipment and surface power shovels. An increase in the use of these alloys may be expected in the construction of underground loading and transportation equipment, but it is essential to retain or even to increase the ruggedness of the current models. Likewise, longer blast rounds in headings, together with closer scheduling for related drilling and hauling, may be expected to increase the loading efficiency at a growing number of mines. In general, schedules of one, two or more complete cycles on a shift could be maintained with the longer rounds of blasts.

As in open-pit mining, success underground in rapid loading depends on the operation of the digging element with a minimum of delay. Thus, with rail haulage, transportation has imposed a limitation on the output of loading equipment due to the restricted size of a mine car and the time required for switching it. This limitation was removed at some stopes in mines of the Eagle-Picher Mining & Smelting Co. by operating a drag scraper in connection with a belt conveyor, which in one installation delivered the ore to a storage bin at the terminal of the haulage track, and, in another, directly to the shaft. This arrangement made possible the continuous operation of the scraper without loss of time for switching cars.

Under some circumstances, there should be a possibility of applying this same combination in driving drifts and tunnels by utilizing a mucking machine and a mechanical conveyor to deliver the muck to a surge bin at a location convenient for rail haulage. This view is further strengthened by the recent successful adaptation of the shaking conveyor to the lateral transportation of ore in caving stopes at certain porphyry-copper mines of the Southwest.

Notwithstanding the disadvantages of the drag scraper, including the time required to set up the scraping rig, the necessity for considerable hand shoveling in the final clean-up, and the difficulty in loading cars heaping full without spilling, scrapers will probably continue to handle a very large tonnage. This is due to their inherent operating advantage, which combines loading with initial transportation, and to the ease of their installation in sublevels in comparison with other equipment.

A recent development in sinking shafts is the Newsome method of large-diameter core drilling controlled by the Idaho Maryland Mines Co., of Grass Valley, Calif. A similar development for sinking winzes is the large-diameter Calyx drill manufactured by Ingersoll-Rand Co. Likewise, the Southern California Cesspool Digger has been adapted to shallow-hole prospecting.

In view of these successful methods now employed in boring large-diameter, vertical holes, the idea of boring large-diameter, horizontal holes for mine openings seems worthy of further study. Certainly its commercial development would change drastically the technique of mechanical loading and underground transportation of the excavated material.

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## IN RETROSPECT

Although open-pit mines and underground coal mines long previously had established mechanical loading as common practice, underground metal mines did not adopt it extensively until the shortage of labor developed during the first World War.

**1922** Efficient drag scrapers developed for stopes and other mine openings, including the conventional size prospect and development headings standard in Western mines. Later, electric scraper hoists with double and triple drums began to supplant the smaller air-operated types.

**1937** In the Tri-State District, scraper hoists were installed on steel slides mounted on caterpillar crawls, thus increasing the portability of the scraper loader and improving the loading practice in that district.

**1932** J. S. Finlay introduced a new design small mine-car loader for use in drifts. The field in which it particularly excels is, in general, drifts with a cross-section of about 5x7 ft.

***In tunnels*** with a cross-section of at least 16x16 ft. the Conway loader, with its dipper, troughed boom, and conveyor, and the crawler-mounted, revolving, electric shovel proved successful where speed in driving was essential.

VIGNETTES OF THE FUTURE

# Ore Transport

## UNDERGROUND

**MARK A. SMITH**
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UNDERGROUND MINING is fundamentally a problem of breaking ore and transporting it to the surface.

Breaking ore is accomplished either by the force of gravity, which is called induced or undercut caving method, or by mechanical and (or) manual means aided by explosives, which is called the supported stope method.

Transporting ore underground involves all phases of conveyance—hand tramming, motor haulage, slushing, conveying, gravity transfer, and hoisting. If the cost of transporting ore to the surface were added to the initial cost of driving all openings used for transporting ore, and to the subsequent cost of maintaining the openings, the total would constitute from 50 percent to 95 percent of direct mining cost.

Unit costs in underground transportation are largely determined by the size of operation—the principle of mass production. Costs are also governed by the physical character of the ore and by the shape of the orebody and its position relative to the surface. The degree of mechanization is most important, but this is ordinarily prescribed by the above conditions. The deep-seated, scattered orebodies mined by the supported stope method as at Butte, for example, cannot be delivered to the surface as economically as the near surface orebodies mined by the large divisor caving method as at Miami—regardless of man's ingenuity.

From this it is obvious that a flowsheet for underground transportation cannot be laid out to best advantage until detailed information of the orebody and the country rock is available. In mines of the future necessary data will be obtained by greatly improved core drills guided by geophysical methods, which will rapidly explore mineralized areas from the surface, and from vertical or inclined circular core shafts.

Possessing these data, engineers of the future will carefully weigh the various factors affecting the economic extraction of orebodies before development work is started.

Large orebodies adaptable to cave mining will have a system of mining conveyors situated near the bottom contact, which will deliver ore to trunk conveyors to be transported directly to the surface. This stream-lined system will eliminate the present devious route of gravity-motor haulage-hoisting systems. Undercutting machines working from the mining drifts will undercut a panel in a matter of hours. Drawing machines will quickly draw the required amount, and automatically weigh, sample, and record their work. With accurately recorded and scientifically controlled draw, the maximum benefit of gravitative crushing action and minimum dilution of ore with waste will follow, thereby increasing the scope of cave mining.

Small, irregular deposits adaptable to supported stope mining will have conveyors of light construction, designed for transporting ore up or down steep grades. After excavating a cut of ore the conveyor will be elevated and its direction reversed to bring in waste from the surface or from some convenient point along the line to fill the stope. This will eliminate the present costly timbered stope methods. The general plan will be to work from the lowest portion of the orebody upward in successive stages.

The metal mining industry has been slow to adopt improved methods and proved equipment in underground transport of ore. This can be attributed to man's inherent resistance to change; a situation under which competitive fields could not long survive. Substantial improvements will be made by employing tools now available, and real progress will start by developing practices and tools specifically adapted for underground transport of ore. Researchers will develop light, fast traveling, trouble free conveyors capable of conveying long distances either up or down steep grades. They will develop efficient underground air compressors for pneumatic conveying, which will play an increasingly important part in future mining. Mining companies will co-operate in research which will lead to a reduction of ore transportation cost underground to a fraction of present costs. Large low-grade mineral deposits, now valueless, will supply the world's metals tomorrow.

Today many will say this is visionary, as many said a few decades ago that heavier-than-air flying machines were visionary. Readers of *Engineering and Mining Journal's* sesqui-centennial number will look back upon us (as we now look back upon the readers of the first anniversary number) and conclude that we were visionless rather than visionary.

### IN RETROSPECT

**1882** The introduction of electric haulage motors was the first progressive step in underground transportation since some primitive genius put wheels under the mine sled to make the mine cart. After centuries of gradual improvements this crude cart, which was the first step toward mechanization, became the mine car which created the demand for mine haulage motors.

**1897** Mechanical scraping or slushing was the next development in the art of underground transportation. In earliest practice single drum air hoists pulled in a loaded slip which was dumped and pulled back by hand. This makeshift contrivance was the forerunner of the present line of scrapers, and two- and three-drum electric slusher hoists. Though limited to relatively short hauls, slushing finds a wide use in mines today.

**1902** Continuous conveyors, introduced early in this century, were a basic improvement over prior, intermittent motor-haulage and slusher practices. The air-driven jigger conveyor was one of the earliest types, now developed into the efficient, electrically-driven shaker conveyor. The use of shakers spread rapidly in coal mines, and is now being accepted in some metal mines. The next important development was the introduction of belt conveyors. Their use, to date, is confined largely to coal mines.

VIGNETTES OF THE FUTURE

# Ore Transport

## OPEN-PIT

**GROVER J. HOLT**
*Butler Brothers*
*St. Paul, Minn.*

TO OBTAIN A GLIMPSE of the future of iron-ore transportation, it is necessary to analyze the industry itself, its ore reserves, and its future operating problems. The industry is being guided by progressive mining men, who are investigating the operation of other types of mines elsewhere in the world as they never have before. The progress will continue. As to ore reserves, the high-grade open-pit ore is becoming exhausted, and cheaper methods of mining and transportation will have to be adopted to increase the depth of stripping allowable. Production of washed or concentrated ore will also increase, which will necessitate lower costs due to decreased recovery ratios. Once the limit of stripping has been reached, the only alternative will be underground mining wherein a combination of new and better transportation systems will be used to lower its high cost.

Inasmuch as the iron mines of Minnesota are limited to a six months' shipping season, the ore must be moved in the shortest possible time to mine the tonnages necessary. From the operating viewpoint, delay is the most costly item in ore production. Thus, ore transportation in open pits must be made as nearly continuous as possible.

In open pits where merchantable ore exists, and where it is loaded directly into cars during the shipping season, an uninterrupted supply of railroad cars is necessary for continuous loading. Here a stockpile, though beneficial, is not as necessary as with other types of ore, as the ore in place may be loaded almost as rapidly as if in stockpile. In those pits, however, where the ore is washed or beneficiated, a delay in transportation from pit to plant results in a loss of the entire payroll for the period of delay. Here, surge bins of ample capacity at the plant will shorten or eliminate delays, provided both loading and haulage capacity exceed the plant capacity. A stockpile for concentrates, moreover, is an important part of surge capacity. In both merchantable and wash-ore operations, larger surge capacity will be provided to minimize delay, especially where intermittent delivery units are used, such as locomotives and cars, trucks, or tractors and wagons.

To minimize delay, moreover, the trend is also away from the use of large-capacity trains requiring easy grades and toward that of higher-speed units on light grades or units which can negotiate heavier grades, such as trucks and tractor-wagon combinations. These new transportation units are of relatively lower capacity, but if used in proper numbers will exceed in aggregate the capacity of the larger units for any given time under proper conditions. In the event of a breakdown of any single unit, only a small portion of the production is stopped and any loss of production is eliminated by maintaining spare units in readiness.

The trend is toward enlarging these small, more mobile units. However, the limit as to size will be found in the economics of operation as well as in the limitations imposed by the motive-power development. In a truck or tractor operation, the time cycle is all important and a limit will be found as to sizes best suited to any operation.

In permitting a continuous flow of ore from pit to surface to minimize delay, the conveyor belt comes into its own. Continuous delivery minimizes the necessity of surge capacity. High cost of installation, however, limits this type of transportation to the orebodies having larger reserves. The limitation upon the future use of conveyor belts will be found in the lack of mobility, and there seems to be little doubt as to the necessity of an extremely mobile gathering unit to feed the belt.

Summing up, in the open-pit iron-ore mines of the future it seems reasonable to expect that the combination of mobile gathering units such as trucks and tractors, will function in the bottom of the pit, transferring their load to continuous lifting units, such as conveyor belts, to provide as nearly a continuous flow of ore to the surface as possible. It also seems reasonable to predict that the plants of the future will be built near the edge of these open pits to minimize the number of transportation devices involved. It is also believed that larger surge capacities will be provided, as stated, all of which should result in minimizing delays, which are serious in a season of limited duration.

### IN RETROSPECT

**1892** Horse-drawn wagons and scrapers, in conjunction with hand labor, used in stripping and mining iron ore at Mountain Iron, on Mesabi Range, first open pit shipper in Minnesota.

**1893-94** Ore transportation system changed by introduction of first power shovel. Horse-drawn 2-cu.yd. dump cars, running on rails, employed.

**1910** Larger power shovels have brought about use of saddle-back dinkey locomotives and 4-cu.yd. dump cars.

**1915** Sixteen- to 20-cu.yd. dump cars and small switching-type locomotives in use.

**1930** Thirty-cu.yd. dump cars and Mallet steam locomotives in use. Electric locomotives seem likely to replace standard steam equipment. Trend stopped by depression. Small standard dump trucks begin to invade locomotive haulage field.

**1933** First belt conveyor installed on iron ranges to transport ore from an open pit. Tractors and wagons begin to be used in conjunction with conveyors.

**1937** First large-tonnage belt-conveyor system in operation.

VIGNETTES OF THE FUTURE

# Ore Transport

## AERIAL TRAMWAY

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FADS EXIST in systems of transportation, as they do in all other fields of human endeavor. At the turn of the century, engineers who faced a transportation problem at once thought in terms of aërial tramways, or electric or steam industrial railways.

In those days the design and erection of aërial tramways did not exemplify the advanced engineering of today, but no one cared. Aërial tramways were generally used to carry all sorts of things for almost any distance. A few of the common things transported were brick, clay, coal, ore, dynamite, timber, machinery, cement, supplies, workmen, passengers, oil, and ashes, a list sufficient to illustrate the great adaptability of aërial tramways.

It is presumed that 10,000 aërial tramways may have been built since 1868. Of these at least 5,000 were carefully designed by competent engineers and rendered satisfactory and economical service. The rest were lines of sorts, built by practical men at great expense and with little success. Many purchasing authorities regarded aërial tramways as an evil to be avoided if possible, especially so when the service required loads beyond 1,000 lb. and speeds over 300 ft. per minute.

We now note the change with passing years. Today aërial tramways can be adequately designed, economically erected, and efficiently operated. They are so improved in performance and safety, that workmen, supplies, and ore are now transported with ease and also with security.

Nevertheless, those who are interested in transportation today think in terms of trucks and buses. Aërial tramways and railroads languish as a sort of "Hobson's choice" when the absence of roads, or steep grades, or barriers like canyons and rivers, turn our contemplation from trucks to long-established systems of transport.

Like all useful devices, aërial tramways and trucks have their place in industry. A comparison of costs by the two methods was prepared and published in *Engineering and Mining Journal*, July 24, 1930. When the life of an enterprise runs for several years and requires the transport of more than 25,000 ton-miles per year, the economies attained by properly designed and constructed aërial tramways cannot be excelled. The explanation is simple. Aërial tramways use the most efficient system of power transmission ever devised—namely, wire rope—and they operate in balance on their own right-of-way and under control. Some think that they suffer from a lack of disseminated gathering power and delivery. Though not possessing the versatility of the truck in this respect, aërial tramways may be advantageously used with trucks, or other auxiliary equipment such as dragline excavators. Aërial tramways are useful, with a minimum of delay in the operating cycle, in the mountains, and on the plains, in fair weather, and in storm, and can transport economically any tonnage required of them.

Aërial tramways can be designed for any capacity desired, to loads of several tons and speeds of 800 ft. per minute. Attention is being given to multiple installations to meet demands in excess of 250 tons per hour. More attention will be given in the future to the proper development of the profile, so that saddle pressures will be equal, and surging suppressed.

For years European rope makers offered lock-coil and half-lock tramway track cables in cast-steel and plow-steel grades. Within the last year American manufacturers have listed the plow-steel grade. This is important, for the ordinary analysis of the bending stress in locked-coil cable indicates the best relation between bending and direct stress is obtained with working tensions in the region of 50,000 lb. (per square inch, instead of 30,000–40,000 lb.).

Aërial tramways are purchased most frequently when times are good, and it is probable that there will be an upswing in demand for them during the war. On the other hand the great development of the skiing art has created a demand for tows, and for passenger-carrying cableways, and the future looks bright for such equipment.

The future also will see a new appraisal of the merits of properly built aërial tramways. This will come when buyers learn to rely upon sound engineering in the design and fabrication of the line. Every undertaking in transportation should be carefully studied by an engineer who is skilled in the art, familiar with its economics, competent to analyze its problems, and prepare the specifications and plans for their proper solution, whether it be in terms of aërial tramways, trucks, or railroads.

### IN RETROSPECT

**1868** Charles Hodgson, of England, is recognized as the inventor and patentee of aërial tramways.

**1876** By this date numerous manufacturers in Europe were busy supplying aërial tramways—Bleichart, Pohlig, Cerretti & Tanfani, Rowe and others.

**1888-95** During this period Trenton Iron Company became agent for Bleichert, and Leschen for Pohlig, and construction of aërial tramways surged forward. Many independent manufacturers came into the field.

**1930** Contractors for great works of United States Bureau of Reclamation used aërial tramways for concrete materials.

**1932** Bureau of Reclamation installed cableway at Hoover Dam with a lifting and rolling capacity of more than 200 tons.

**1937** First passenger carrying cableway installed at Mt. Cannon, New Hampshire.

***World distribution*** of aërial tramways: Asia, 350; Europe, 4,000; England, 900; Africa, 400; North and South America, 1,200; Australia and others, 150.

VIGNETTES OF THE FUTURE

# Hoisting

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WITH THE GENERAL TREND towards mechanization in mining, increase in depth will allow orebodies of lower grade to be worked and more tonnage to be hoisted. Obviously, hoisting is destined to play a rôle of increasing importance in mining economics. Although it is a long way from hand windlass and horse whim to the modern bi-cylindro conical-drum balanced hoist equipped with an Illgner-Ward Leonard drive, one may still look forward to radical changes in equipment and procedures.

Strange as it may seem, when Ewing and Eagen showed the practicability of converting the energy in compressed air into both mechanical work and refrigeration for air-conditioning the mines on the Rand, they made hoisting a hand-maiden of air conditioning and ventilation in deep, hot mines. They also applied an important thermodynamic law. Application of these principles practically limits to 4,000 ft. the depth from which a surface hoist should operate, for at that depth underground temperatures reach about 100 deg. F. Beyond that depth the endeavor will be to find uses for devaporized compressed air in underground hoists, for they produce cold in addition to mechanical work at efficiencies approaching 100 per cent.

Thus one may conclude that for underground mines at depths up to 80 deg. F. the type of energy used will be mainly electrical. At depths beyond 80 deg. F. the type of energy will be compressed air in machines which use it expansively, or electrical energy from a generator driven by a device using compressed air expansively. We anticipate the development of both types of equipment for deep, hot mines.

Power requirements for hoisting will increase as mines deepen and tonnages become greater. They have been reduced in the past by balancing the hoist, coning the drums, and developing more efficient generating and driving equipment. Development of the Ohnesorge pulley and its use in Europe showed the possibility of reducing power requirements further by eliminating the inertia of large drums and the amount of rope.

Driving methods, besides the induction motor, are the Ward Leonard, comprising a motor-generator set supplying a hoist motor; an Illgner-Ward Leonard set comprising a motor-generator set plus a flywheel driving a hoist motor; and the Stubbs Perry arrangement comprising a turbine-generator and flywheel driving a hoist motor; and we look forward to the development of a compressor-generator and flywheel set driving a hoist motor for underground work.

At present, legal requirements as to rope safety factors and hoisting speed should be repealed. These matters had best be left to the profession.

Present procedures in respect to shaft timbering and supporting guides are rule-of-thumb. Serious consideration of this problem, especially in shafts sunk through hard rock, leads to the conclusion that the only load the timbers ever support is that transmitted by the guides when the safety dogs take hold. Why we continue to use dogs, which take hold immediately and thus exert infinite forces on the guides and timbers if ever the rope breaks, is a puzzle. Realizing that braking must take place through a reasonable distance and that safety dogs are brakes, I think it logical to expect that with present knowledge a cage or skip may be braked to a stop in case of rope failure within half the distance used for its acceleration. The shaft may also be extended a short distance as an additional safety feature.

For inclined shafts the opinion seems to be that safety devices are impossible. I disagree and recommend compulsory safety devices, leaving the design to the profession.

Skip hoisting is likely to be favored; likewise a decrease in the skip-loading time to increase the hoist capacity. Underground crushing stations will become more common. Signaling, at present fairly well developed, will also have communication systems available between skip and hoistman, probably of a wireless type. Buckets, cages, and skips will be made lighter and of alloys. The wire-rope manufacturer will probably continue to improve his product.

Determination of shaft pillars and their shape; the effect of mine workings on shaft alignment, support, and design in bursting ground, are all part of the hoisting problem definitely in the field of barodynamics.

## IN RETROSPECT

**1710** First steam engine erected at Huel Vor, a tin mine in Breage, Cornwall, for pumping.

**1753** Patent granted to Michael Menzis for hoisting method consisting of lowering full water buckets to lift balanced coal bucket. Water was dumped and later pumped out. It lifted 600 lb. of coal at a time out of a 600-ft. pit.

**1790** The first direct coal hoisting engine was erected at Oakthorpe colliery, in Measham, England.

**1798** Flat rope invented, reducing starting loads on hoisting engines.

**1841** Light round wire rope was introduced to replace flat rope.

**1880** Tendency toward coned drums and efficient steam engines for hoisting very pronounced.

**1923** Tendency toward electric hoists with Ward Leonard control and flywheel for hoisting from deep shafts.

**1930** Introduction of Ohnesorge pulley and hoisting systems in Europe.

**1935** Single-stage lift of 6,300 ft. installed at Simmer and Jack mines.

VIGNETTES OF THE FUTURE

# Ventilation

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DESIGN OF ALL TYPES of mine fans has been continually improved. Early centrifugal fans were of large size and costly to install. Later centrifugal fans of the multivane type are built with farward- and backward-tipped blades of various designs and proportions. They are smaller in size than the old types, run at higher speeds, have more favorable power characteristics, and cost less to install.

With the development of the airplane more scientific knowledge has been gained of propeller characteristics, and propeller mine fans have come to occupy a place of increasing importance. As it is not possible to design a propeller blade for maximum efficiency in one direction of rotation, and obtain the same efficiency in reverse, fans of this type have some limitations in reverse operation. However, those having adjustable blades may be better adapted to variable mine conditions.

Though marked improvement has been made in the design of the mechanical equipment used for the ventilation of mines, it can hardly be said that equal progress has been made in the design and maintenance of mine air courses. The weight of air passed through any mine requiring thorough ventilation may often be ten or more times that of the ore hoisted, so that good engineering in the design of the "roadway" is of considerable economic importance.

## IN RETROSPECT

***During the sixteenth century*** **it seems to have been believed that satanic influence was responsible for the presence of unwholesome vapors in the shallow mines of those times, and the earliest method of eliminating them was probably the "beating out of the gas" by movement of a jacket, or a cloth.**

**1764 M. Jars, a celebrated French mining engineer, published a memoir describing the fundamental principles of mine ventilation, and an illustration in Agricola's "De Re Metallica" shows the use of a blacksmith's bellows to create a mechanically induced flow of air through mine workings. Since then, such able men as Murgue, Atkinson, Davy, and many others have made notable contributions to the art with very valuable results.**

**At present a majority of large underground mines are mechanically ventilated by reversible fans, usually installed at the surface, and their action in inducing a flow of air through the mine is often supplemented by underground booster fans, and by blowers forcing air through tubing for the ventilation of dead ends.**

In recent years the hazard of high dust concentrations in mine air has had an important influence on mine ventilation requirements. Methods of dust prevention play an important part in preventing the dissemination of dust into the air, but because none of them is completely effective, there will always be a tendency towards building up dust concentrations unless a sufficiently large volume of air is in circulation to sweep such accumulations out of the mine. Even before the air passes out of the mine, a considerable amount of dust may be eliminated from humid air by being impinged against moist surfaces of the air courses.

Air conditioning, or air cooling, methods for the improvement of temperature and humidity conditions in deep mines have assumed importance slowly because not many mines require such methods. The most important difference between plants now in operation is that at some of them the air is cooled at the surface before it enters the mine, whereas at others the air-cooling plant is placed underground nearer the working zone. In the selection of either method local climatic conditions must necessarily be taken into consideration. In tropical countries where the air entering the mines is warm and humid it will naturally be possible greatly to reduce the heat condition of the air, and this will be more effective in improving conditions within the mine if large-sized shafts are available to carry a large volume of air. Similar benefits can hardly be expected in climates where the air entering the mine is dry and cold, so that its heat content is smaller, and this will be particularly true if the shafts are of small size, so that the volume of air circulated through the mine is small.

In either case, because of transference of heat from rock to air, the benefit derived from cooling the air diminishes as the distance from the air-cooling plant to the working zone increases. Where ground temperatures are very high it is impracticable to carry air for long distances or at low velocities without experiencing such gains in the heat conditions of the air as to nullify largely the effect of the air-cooling plant. For the ventilation of dead ends in the Butte district, portable air-cooling plants have been designed to cool air forced through tubing to the working face. Experience indicates that under these conditions the distance from cooling plant to face should not exceed 500 ft.

Looking to the future, it seems that state-sponsored demands for improved standards of industrial hygiene, or limitations on the dust concentrations carried in mine air, may impel the adoption of mechanical ventilation at many smaller metal mines that now have only natural draft ventilation. At some deeper mines air conditioning for the elimination of dust may receive more consideration. Filtration and air washing have already been employed in a number of installations, and with further development and improvement of the art electric precipitation and other methods may come into increasing use.

VIGNETTES OF THE FUTURE

# Mining Engineering

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IN MINING, the trend has long been toward mechanization. The usual resistance has been made to the introduction of new ideas and inventions, coming often from men deficient in vision and ability though of considerable prestige. The story of this resistance might be told with respect to the rock drill, the pump, the fan, to haulage and hoisting equipment, to geophysics, barodynamics, and most of the advances made in ore dressing.

Mechanization of hoisting, haulage, drainage, and ventilation has increased the vertical depths to which man may work and the horizontal areas workable from one opening, making it possible to mine at a lower cost. Recent progress in loading and breaking at the working face will greatly influence future mining, wherever the orebody's character permits.

In loading with machines the tendency as with other mechanical devices is continually to increase capacity. At present, machines are available which will load 2 to 5 tons a minute, but, with a high initial cost, they must be worked continuously and produce maximum amounts or their purpose will be defeated. It follows that mining procedures and working places must be planned to attain these outputs. To do this with an art practiced for centuries by individuals, requires the elimination of mental inertia and the substitution of a better understanding of the behavior of a complete geological structure. Workings, particularly in flat deposits, should be designed so that a minimum amount of artificial support will keep them open for a sufficient time to allow safe and economical extraction with machines. The time factor will play an important rôle.

Though mechanization has increased the depth to which orebodies may be worked, we are now limited by bursting rocks, which is a matter of grave concern in the Rand and Kolar gold fields, the Kentucky and British Columbia coal fields, and several Canadian copper, gold, and nickel producers. What causes them and how they can be predicted, prevented, and controlled are questions which we must now answer.

Block-caving is still largely an undetermined art and its status has been well expressed by one of the most successful caving men, as follows, "After we get through block-caving an orebody we think we know what should have been done in the various blocks. Our position, however, is not greatly improved when attacking a new orebody."

These are a few of the problems that challenge the profession today. They are being attacked in the field and in the laboratories and many of them are well on the way to economic solution.

It is significant today that (1) mechanization at the working face, (2) the extension of workings to depth, and (3) the use of gravitational forces in breaking orebodies, as in block-caving, are dependent upon a knowledge of the behavior of a mine's geologic structure when acted on by gravitational forces. This field is termed barodynamics.

Growth of knowledge in this field in recent years has been due to a realization of the existing problems and the theoretical and laboratory attack that is being made on them. The reader should know (1) that laboratory longwall model studies are verified by several years of field observations, (2) that photo-elastic-model stress studies agree well with the determination of high and low-stress areas in the field, (3) that ores may be made to block-cave in the laboratory, and (4) that a theory of block-caving is to be shortly available. Within the realm of our experience it is evident that the finding of orebodies is being subordinated to economic extraction. The prospector, geologist, and those concerned with extraction and refining, have, by their improved practices, continually made available the orebodies which at one time were not economic.

It is reasonable to expect that mechanization will assume an important part and that its growth will depend on increased knowledge of barodynamics. Future prospecting will pay as much attention to determining the physical characteristics of the rocks making up a mine's geologic structure as to the assay value of the ore. Mining methods and procedures will be based on laboratory studies and tests, while the dimensions and support of openings and the timing of underground events will be governed by laws more specific than mere human impressions of eye and ear.

## IN RETROSPECT

**1812-13** George Stephenson first made use of mechanical rope haulage underground at the Killingworth colliery in England.

**1849** First steam percussion rock drill invented by J. J. Couch, Philadelphia.

**1860** Square-set stoping was introduced by Philip Deidesheimer at the Ophir mine, Comstock Lode, Nevada.

**1861** The compressed-air rock drill was introduced for driving the Mont Cenis tunnel in the western Alps.

**1870** Rope haulage introduced into the United States.

**1875** Locomotive haulage introduced into the United States.

**1890** Approximate date at which top-slicing was introduced at Lake Angeline mine, in Michigan.

**1908** Trial of mechanical loading devices underground.

**1930** Development of laboratory methods, apparatus, and procedures for solving problems concerned with support and behavior of mine structures and orebodies.

VIGNETTES OF THE FUTURE

# Mining Methods

**LUCIEN EATON**
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THE TECHNIQUE of open-pit mining has been perfected to such an extent that only minor changes may be expected. In large operations electric shovels and electric haulage will continue to lead, but the day of the gigantic shovel, except for stripping, is past. In smaller pits and for short hauls trucks will serve diesel or electric shovels, and belt conveyors, scrapers, and bulldozers will be used to meet special conditions. The economic limit of stripping has not been reached.

In underground mining complete mechanization will be the rule, especially at the larger mines. At smaller mines mechanization will not go so far, but the plants will be self-contained and easily moved. In vein mining the present trend from shrinkage stoping to cut-and-fill to reduce dilution will continue; and, as the cost of timber increases, a greater use of fill is to be expected, but hand methods of placing it will undoubtedly be generally abandoned.

In the past the development of mining systems has followed the trends toward mechanization or of complete or partial elimination of one or more of the four major operations of mining—breaking ore, loading, transportation, and timbering; but these savings have been at the expense of an increase in stope preparation, made possible in part by increased speed and efficiency in drifting and raising.

## IN RETROSPECT

**1865** Invention of square-set timbering on the Comstock Lode, in Nevada.

**1884** Development of top-slicing and sublevel caving on the Marquette Range, in Michigan.

**1892** Application of the steam shovel to open-pit mining on the Mesabi Range, in Minnesota.

**1895** Development of block-caving at the Pewabic mine, on the Menominee Range, in Michigan.

**1902** Introduction of sublevel stoping on the Menominee Range, in Michigan.

**1910** Introduction of block-caving with branch raises in mining porphyry copper ore at Ohio mine, Bingham, Utah.

**1929** The adaptation of sublevel stoping to flat ore at Roan Antelope, in Northern Rhodesia.

**1936** The introduction of truck haulage in open-pit mining on the Mesabi Range, in Minnesota.

**1938** The use of deep-hole and diamond-drill holes in sublevel stoping at Noranda, in Quebec.

In the past the cost per workman for opening and equipping a mine must have been much smaller than it is now. At present an investment of $5,000 to $10,000 per man employed is necessary in a well-equipped mine, the average being probably about $7,000. How far this increase in investment will go in the future it is impossible to predict. It is fostered by a rising wage scale, but limitation of output per man by the labor unions will check it, and it is possible that exhaustion of capital as a result of the present war may act as a further deterrent.

The exhaustion of rich veins that could be opened with small capital outlay and could be made to pay for their development and equipment out of earnings long ago concentrated attention on large low-grade mines, which required huge capital investments. Now that the easily discovered low-grade deposits, that can earn profits under present conditions, are also on their way to exhaustion, the trend will be in two general directions: (1) to work deposits of lower-grade ore near surface, and (2) to find new deposits at greater depth. In mining the deposits near surface open-pit methods will be used to a greater extent than heretofore. In underground work the choice of mining system for low-grade ore will be influenced more by low cost than by complete extraction, but more attention will be paid to clean mining and avoidance of dilution.

In mining deep ore, shafts will have greater capacity, and will be spaced farther apart, and ore will be transferred greater distances vertically and horizontally from unit areas to definitely established lines of haulage. Mining methods that produce large amounts of ore from small areas, such as sublevel stoping and undercut caving in their many variations, will be more generally used, and breast stoping of thick beds in room-and-pillar mining will be modified to produce greater tonnage per room. The use of scrapers, conveyors, and self-propelling trackless haulage for gathering and transfer to the main line will make it possible to follow the ore with less regard to gradient than heretofore.

Counteracting the tendency to concentration of production in large mines, mining small deposits both underground and as open pits has received an impetus lately from the use of self-contained equipment and of methods of mining that produce a large output from a small area. Success has been achieved by working several small mines successively at a rapid rate, the equipment and personnel being transferred from one mine to the next and the product being hauled to a central treatment plant. At the same time selective mining of narrower widths of ore has raised the quality of the product without material reduction of output. Practice of this sort may be expected to expand.

In all phases of mining there is a growing need for better planning and of more highly trained personnel, and the proportion of technically trained men in the industry will continue to grow.

VIGNETTES OF THE FUTURE

# Dredging

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THOUGH THE PAST HISTORY of placer bucket-elevator dredges reveals advancements in the various units making up the dredge comparable to the progress made in other mining industries, the principle of the dredge has not changed. Due to the fact that this type of equipment produces a continuous flow of materials more uniform than is possible by other means, the future will see a continued use of the dredge, but with no radical changes in the fundamentals of the dredge itself. However, the individual units making up the dredge will be changed for greater efficiency; the dredge will be adapted to greater ranges of activity such as greater digging depth, working of more difficult formations, and handling lower-valued gravels profitably.

Though depths as great as 175 ft. below ground level are now being dredged successfully, the future will see still greater depths reached by this type of dredge. Depths far beyond 200 ft. will be dredged at a cost comparable to our low cost of today's operation on shallow placers (under 80 ft.). These dredges will have hulls that are unsinkable under all conditions except willful destruction. Electrical devices, synchronized with the action of the various motors that could cause dangerous heeling, will be installed to keep the listing automatically within safe limits. Greater depths will dictate large-size hulls, making possible the installation of electrical generating systems on the one-dredge projects that will produce power at a lower rate than obtainable today. Power can be supplied to points off the dredge for camp and shop use.

Buckets for these dredges will reflect a radical change, both in size and design, possibly including a new method of connecting buckets by pins of different design than used at present. These buckets will be driven by a device different than the present tumbler, and they will run on a trussed ladder rather than the plate-girder type now used. The ladder may be suspended at a different point, using a double lift system. Electrical devices will indicate the position of the buckets in relation to the lower tumbler and control the digging, assuring full buckets, even when variation in formation is encountered, without the danger of a bucket line running off the lower tumbler.

Material dredged will be more thoroughly sized than at present, no matter what variations are found in the formation, assuring all materials of a certain size being passed on to the treating system. This treating system will be such that practically no losses will occur. An automatic check will be made on all materials at the end of the treating system, and where values are indicated, this material will be bypassed to the head of the treating system for further working. The other units making up the dredge will show the same advancement for greater efficiency and lower cost of dredging. The tendency will be towards use of labor-saving devices such as automatic lubricating systems (one of which is now on the market being tried and indicates successful operation), and also less manual and more electrical control of the operations. New alloys will be used to prolong the life of the various parts. Some such changes are now being forced, and new alloys are required because of defense requirements.

Present-day cost of operating dredges, especially on shallow placers, is outstandingly low, but the future will see even lower costs. This will be accomplished by using many improvements mentioned in the foregoing, so that the efficiency of the dredge will improve along with development of the deep-digging equipment. The bucket-line drive, especially, will be changed as already mentioned, to improve the efficiency and also to get away from the troubles encountered with the high-speed lines of today. Reduction in operating costs will have to be sufficient to more than take care of the higher taxes that will be imposed as indicated by the present trend.

The future for remote placer operations will depend largely on the mining engineers and prospectors. The accomplishments of the Bulolo organization in transporting equipment by airplane prove that even deep-digging dredges as described herein can be sectionalized without loss of efficiency. Further development of the airplane will make possible transportation of much larger unit loads. The task of the dredge designer will be much easier in the future than was the condition when Bulolo's dredges were first designed for transportation by air. This will make possible the equipment of deep-lying placers.

## IN RETROSPECT

**1805** In Philadelphia, Oliver Evans invented and built "Amphibious Digger" for digging on land or water with a chain of hooks to break the ground and buckets to elevate material.

**1850** Near Marysville, Calif., a small river boat, "Phoenix," was fitted as a dredge to mine placer gold from Yuba River. Endless chain of scoops elevated gravel to a rocker-washer. Screens were used; also a "Bogardus Patent Amalgamator."

**1895** Bucket-line flume-type dredging started on Grasshopper Creek, in Montana; dredge "Fielding L. Graves." New Era Gravel Mining Company operated a bucket-line dredge with flumes on Yuba River, California.

**1898-1910** This period marks rapid development of modern California-type dredges, particularly on the Feather and Yuba Rivers, incorporating close-connected bucket-line and rubber stacker belt.

**1930-40** California-type dredges developed to present high standard typified by Yuba No. 20, an 18-cu.ft. dredge capable of digging 124 ft. below water against banks 50 ft. or more high.

VIGNETTES OF THE FUTURE

# Crushing and Grinding

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ON THE GENERAL THEORY that man's ingenuity eventually finds a way to circumvent his troubles—at least those of a mechanical kind—the best way to look into the future is to examine the difficulties of the present.

Primary crushers weigh too much and spend too much time and power in idling. Their feed must be watched closely, and they are too difficult to lubricate effectively. Weight reduction will decrease idling power, as will improved lubrication, but real saving in this respect involves elimination of idling. A positive automatic feeder from coarse-ore storage, plus larger fine-ore storage than is currently usual, would permit full-time primary-crusher operation, ex-idling; in many operations it would allow use of a smaller primary; with properly proportioned secondaries, it should make the crushing week five days and thus eliminate overtime from this department. If, at the same time, stray timber, shovel teeth, jackhammers, and other indigestible tidbits could be eliminated from the feed mechanically, primary crushing might almost become a money-making operation.

Lubrication difficulties will be ameliorated when science finds out what lubrication means. In the meantime much can be done by utilizing the empirical knowledge of refinery engineers. Lubricants can be specified more accurately by physical and chemical properties than by name. Research is learning the properties requisite to particular services, and refinery sales departments are glad to have specific problems posed.

In secondary crushing the principal difficulties are damp sticky feeds, tramp steel, maintenance of crushing faces, irregularities in feed rate, and the ubiquitous lubrication problem. Scalping or, in aggravated cases, washing, is the best present solution for sticky feeds. The springs provided on secondaries are far from full protection against uncrushable material; if tension is kept effectively low, oversize is excessive under heavy feed load. Magnets, and electric eyes relayed to circuit breakers, are helpful but far from infallible. Wear of crushing surfaces is painfully high with damp abrasive feed. In addition to actual abrasion wastage, worn faces loosen or crack, causing delay as well as further steel loss. Removal of worn parts and installation of new is too laborious and expensive. Heat-treated alloy steels which promise long life are the present remedy, but such correlated knowledge of their composition, manufacturing treatment, and service properties as is necessary for intelligent specification is lacking. Modern mill designers equalize feed rates to the fine secondaries by adequate surge bins and constant-weight feeders; this probably constitutes a solution that will hold for a considerable time.

Grinding is the most expensive single operation in many modern mills. Grinding machines all have the amazing characteristic that they must move relatively tremendous masses of metal in a zone in which the material to be ground is relatively sparsely dispersed, and depend upon chance to bring the particles in the way of the masses. All rotate the grinding media, but in the tumbling mill, which is most used, the rotation is off-center, unbalanced, and correspondingly inefficient. All consume relatively tremendous quantities of steel, both by abrasion and rejection. Power consumption, compared to useful effect, is out of all proportion to that expended in primary and secondary crushing, where the stream of material to be broken, although sparsely dispersed, is positively introduced into and held in the breaking zone. Tumbling-type mills consume more power when they are not grinding than when they are. There is, of course, something fundamentally wrong from an efficiency standpoint with such a machine. But until we know more about what constitutes useful work in grinding, we have no basis for corrective criticism. It is not improbable that the scientist who solves the problem of measurement of grinding efficiency will be the person who contributes the key solution to many of our present difficulties.

Operators have learned that though the best feed size to grinding units is an economic question to be solved only by an over-all consideration of plant tonnage, primary and intermediate crushing, and tailing and concentrate assays, as well as the grinding unit itself, control of feed rate in such a way as to make the work demand on the grinding mill a constant is a *sine qua non* for efficient performance.

## IN RETROSPECT

**1556** The gravity stamp, which substituted the kinetic energy of flowing water and the force of gravity for the muscular effort of man, was already established in the art. It was the only mechanical crusher of note for 250 years thereafter.

**1806** Rolls were put to work in the Cornish tin mills. They have been speeded up, and have increased in size, but no new principle of design or operation has been discovered.

**1858-69** The jaw crusher and the gyratory, respectively, applying the elementary mechanical principles of the lever and the wedge, the first in reciprocating and the second in rotary fashion, were invented. Between 1920 and 1925 the gyratory was provided with the discharge area necessary for economic operation as a secondary crusher by flaring the crushing zone downwardly and outwardly, and speeding it up, which permitted a larger setting for a given discharge size.

**1880** Tumbling relatively large heavy bodies (pebbles, balls, rods, and the like) in a shell of circular cross-section, in order to grind smaller particles included in the tumbling mass, was imported into ore-milling practice about this time. The principle probably dates farther back.

VIGNETTES OF THE FUTURE

# Gravity Concentration

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THE GENERAL OUTLOOK for gravity concentration is favorable, as indicated by the following factors: (1) Concentration of non-sulphide ores is on the increase and, as many of them can be concentrated at relatively coarse sizes, they will be treated by gravity methods. (2) There is recognition that gravity methods have a place in many sulphide mills to rough out low-grade tailings or to recover concentrates at relatively coarse sizes. Examples are the introduction of jigs and tables in some grinding circuits and the use of "heavy-medium" processes at two large sulphide mills to rough out low-grade tailings. (3) Availability of cheap and effective wetting agents can extend the usefulness of gravity methods for minerals that do not wet readily. These agents can be added to the circulating water to reduce the tendency for unwetted minerals to float off into the tailings.

All important gravity processes involve a heavy medium of some sort, and they may be grouped in a broad way according to whether this medium is developed from the ore being concentrated, as in jigs or tables, or is supplied artificially, as in the Chance or the Wuensch process. The first group has advantages in the form of low first cost of plant and low operating cost, but is at a disadvantage compared to "heavy-medium" processes when the difference in specific gravity between concentrate and gangue particles is small. As this disadvantage is largely that the medium specific gravity is low, the remedy lies in building it up.

The logical place to start is with preparation of the feed so it will have a screen analysis adapted to the concentration process. A second step is the use of a circulating load closely controlled to supply specific gravities and sizes deficient in the original feed. To obtain the right mixture for recirculation, screening or other treatment may be needed. Now that the possibilities of circulating loads are being realized in relation to this problem, one may expect the heavy-medium principle to be applied to all gravity processes—jigs, tables, etc.

Listing of possibilities for improvement in the first group, other than building up the media, might well follow, but limitations of space permit of only two instances, both in the field of jigging. One is the adoption of the Baum jig in ore dressing. Its distinguishing feature is that the pulsations of water are produced with compressed air. Because of its flexibility this jig can open up a new field in jigging. Development of slow-speed jigging, moreover, has important possibilities for ores. Over a dozen high-capacity coal jigs are working at less than 30 strokes per minute. Whether such low speeds can be considered for ores is problematical, but enough work has been done to show promise for speeds of 45 strokes per minute. With these possibilities as starters significant advances should be made.

One forward step for the second group of processes is preparation of the media from the ores treated. That this is possible for certain ores, at least, is evident from the case of one iron ore. The mineral particles had a specific gravity of 5.1 and a medium of selected sizes suspended in water was made up with a specific gravity of 3.2. Moreover, many low-gravity ores contain a small percentage of materials of suitable specific gravities that might be collected and used as a medium. Again, a number of properties have some high-gravity ores and most others can obtain them near by. Thus media derived from the ores treated have become a distinct probability for the future.

A second step forward for heavy-medium processes lies in treating unsized ores with the natural fines included. Such a process will necessarily be incomplete within itself, for the small particles of ore that approach in size the particles that comprise the medium will not be concentrated. However, much smaller sizes can be concentrated with heavy media than is current practice. Moreover, a study of present heavy-medium processes indicates that they could also handle unsized feeds. However, conditioning of the medium to remove fine gangue and possibly fine concentrates would be much more of a problem than at present. Thus a process is needed for treating large tonnages of fine sizes at low cost, and with small losses. Now that the problem is recognized, a solution to it is to be expected, and with it another forward step will be recorded in the development of the heavy-medium process.

## IN RETROSPECT

**1556** Prior to this date, the intermittent basket-type jig and trough washer.

**1828** Fixed-sieve intermittent jig (step towards Harz jig).

**1840-45** Vanner-type table, widely used in slime treatment before flotation. Followed by spitzkasten classifier, an early attempt to prepare fine ores for tabling.

**1848** Continuous jig (big step toward high-capacity jigs).

**1860** Harz jig (long dominated ore jigging. Still used).

**1868** Air jig—a forerunner of dry tables.

**1892** Baum jig (air-operated). A major advance.

**1895** Wilfley table. It brought about a major change in the technique of gravity concentration.

**1912** Rheolaveur process (flowing current).

**1915** Chance process (artificial heavy-medium). Used on coals. 1931 Wuensch process (artificial heavy-medium).

VIGNETTES OF THE FUTURE

# Flotation

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FLOTATION HAS BROUGHT MANY CHANGES in the mineral industry; in particular it has cheapened the metals. The process was born shortly after the turn of this century, although its family tree can be traced back with some assurance to the experiments of Cattermole and Everson, of the Bessels, and even to a Persian manuscript dated 1492. Satisfaction at the progress made is tempered by the knowledge that present practice is capable of improvement as well as of extension to new fields. Current problems are dealt with as follows:

*Improved Separation*—Defective separations are due to some of the following causes: (a) inadequate liberation of the minerals, (b) non-selection among very fine particles, (c) inappropriate agents. Much progress in improving liberation of sulphide ores has already been made, especially through use of quantitative microscopy and of regrinding circuits. Satisfactory flotation of particles of near-colloidal sizes, however, is still unachieved. The need for solving this problem will be particularly acute in treatment of non-metallic ores.

Our understanding of the use of reagents has gradually improved. However, it leaves much to be desired: in the treatment of sulphide ores, our understanding of the action of naturally occurring soluble salts and of their cooperation with depressing agents is mostly guesswork; in the treatment of non-sulphides, our ideas on flotation reagents in general are mostly inferred by analogy with what is known in the treatment of sulphide ores. As in the past, increased understanding of the functions of reagents will be reflected in better operation.

Material betterment of current practice may come out of a sharper grasp of the kinetics of particles and bubbles in pulps. Study of this subject will lead to the production of high-grade concentrates and it may help in directing investigators to a solution of the slime problem.

*Cost Reduction*—The inverse relationship of cost to size of unit is well accepted; it is, therefore, surprising to find that small flotation cells are still widely used. Considerable enlargement of cell size promises increased economy in power, supervision, and repairs, and decreased capital expenditure; it will also make more attractive the installation of automatic devices for control of operating variables.

These automatic devices might include not only pH recorders and controllers, but also devices to regulate air pressure and cross-sectional area of froth so as to maintain optimum froth depth and optimum froth mineralization. Automatic analysts capable of continuously sampling and analyzing mill products will perhaps provide a continuous record.

In some cases over-all economy will be bettered if other processes are used in coordination with flotation, as for example some of the heavy-fluid processes, cyanidation, or other forms of leaching.

*New Fields*—It has been demonstrated in the laboratory that almost all minerals are capable of being floated. Concentration of iron ores by flotation is a field that practically remains untouched. Here again the difficulties are not only in the flotation of the iron minerals, but in the utilization of the concentrate. Should the present rate of ore consumption in this country continue, the prospect of flotation becoming applied to iron ores will be measurably nearer realization. As for cassiterite, although it has been floated in the laboratory, practical use of flotation in tin-ore treatment has not followed. Research in this field would have strategic as well as practical significance.

Recent work has shown that the different constituents of clays have widely different ceramic properties. If clays can be fractionated by flotation, an interesting expansion of the ceramic industry might well become a possibility.

In the field of metallurgy finely ground machine-shop wastes may be separated by flotation; it may perhaps come to pass that metallic inclusions in fused slags will be removed by flotation.

All in all, it seems fair to predict that the next 75 years will bring many marked improvements and startling advances in flotation. Short of an unforeseen new and revolutionary development, the center of the stage, in so far as mineral dressing goes, will continue to be held by the interplay of gravity and bubbles.

## IN RETROSPECT

**1492** Persian manuscript by Mansur records mineral purification by selective adhesion to oil and to water.

**1877** The Bessel brothers, in Germany, discover oil-froth purification of graphite ores.

**1905** Collective sulphide-mineral flotation made practical by inventions of Higgins, Sulman, Picard, and Ballot.

**1913** Bradford discovers that copper salts help float zinc blende, but his discovery is not fully appreciated.

**1915-20** Introduction of chemical collectors and alkaline circuits leads to increased utilization of flotation.

**1922** Sheridan and Griswold and others perfect lead-zinc and copper-iron selective flotation.

**1924** Soaps introduced for collecting non-metallic minerals.

**1930** Table agglomeration of phosphatic sands in Florida.

**1933** Invention of cationic collectors for floating silica and silicates.

VIGNETTES OF THE FUTURE

# Cyanidation

**J. V. N. DORR**
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LEAVING THE ESSENTIAL CHEMISTRY of the cyanide process unchanged, the milestones that have marked its progress in ore treatment consist chiefly in mechanical developments to facilitate the chemical reaction on a large scale. The progress thus made has been very great; and if we consider the numerous special problems that have been solved by hard, intelligent work, we can well say that the picture is inspiring and that the fraternity of metallurgists and millmen who are working in the far corners of the world, ever ready to exchange experience with their fellows, has much to be proud of. With them have labored helpfully the great teachers in schools of mines and universities who combine theory with practice and experience; and others who have supplied some of the tools and who find their usefulness increasingly dependent on their ability to make worthwhile contributions in ideas and service as well as in iron and steel.

Viewing the future we see a growing emphasis on the items of cost and recovery—two factors that sometimes tend to balance each other. Frequently, though not always, an improvement in the one may make the other worse.

The major items of cost are labor, power, maintenance, and chemicals. Labor cost, while largely a function of the size of the operation, can be greatly affected by design and control. I have just learned of a new chemical plant designed after an intensive study of station location, in which one man with numerous controls and fixed spy glasses to read distant indicators replaced ten men required in the old plant.

Power also depends on design and the work to be done. Maintenance is affected by design and organization. Chemicals are much affected by control; also by the recognition of the fact that many ores present complex chemical reactions that call for exact knowledge of the optimum conditions to encourage or inhibit them. The chemist who sees in his pulps and solutions the molecules and ions with their likes and dislikes and sensitiveness to changing conditions will go much farther than the empiricist in effecting profitable control. In an instance that recently came to my attention A. J. Clark and his associates increased extraction by reducing temperature. All of which suggests much interesting research work and raises the picture of the day when the physical chemist, with his exact measurements and his search for the "why" of things, will be as essential to successful management as the geologist is now. Such instances indicate the increasing importance of plant control in cyanide strengths and alkalinities as an offset to the old alibi, "change of ore."

It is common knowledge that every art "gets from and gives to" many others. Thus cyaniding has given mechanical classification, closed-circuit grinding, and much more, to other industrial processes; and I feel that it has fair prospect of gaining much from flotation, including recognition of surface chemistry and physics and the theory of adsorption.

One great hope for improvement in cyanidation is the growing recognition that no universal method can be applied, but that metallurgy must be tailor-made to suit each ore, just as each orebody presents an individual mining problem for its extraction with greatest profit.

One friend has written me that if the authenticated unusual experiences of operators were collected in a book, it is quite possible that from a number of apparently unrelated facts might come hypotheses and theories that would result in great economic advantage. For example, one company after many years' use discarded lead in solution, another added copper sulphate, and still others used mercury.

When we consider the problems of refractory ores, those that are copper-bearing stand out with their challenge for base-metal recovery. Cyanide regeneration also offers opportunities for research. And finally, who knows that some day, when our synthetists have given to this branch of metallurgy the same amount of study they have given to many other chemical problems, they may not evolve a new solvent for gold that has fewer disadvantages than cyanide. May not the recent report on the biological preference of certain shrubs for gold-bearing soils suggest a future development?

## IN RETROSPECT

**1887** MacArthur and the Forrests discovered that dilute cyanide solution dissolves gold from ores, and that finely divided zinc precipitates it.

**1889** First successful cyanide plant started at the Karangake mine, New Zealand, followed by one at the Robinson, South Africa, in 1890, and at the Consolidated Mercur, in Utah, and the Calumet, in California, in 1891.

**1907** Continuous slime thickening and counter-current decantation made possible by Dorr thickeners. Sometimes followed by rotary vacuum filters. This method superseded intermittent collection, agitation, and decantation.

***Closed circuit grinding*** in tube and ball mills using Dorr classifiers reduced grinding costs, increased extraction, and simplified "all sliming" treatment.

***Zinc-dust precipitation***, originally suggested by Forrest and MacArthur but abandoned for patent reasons, first used continuously by Merrill at the Homestake in the early 1900's. Method improved by Crowe's vacuum process.

VIGNETTES OF THE FUTURE

# Dewatering and Washing

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RAPID IMPROVEMENT OF METHODS in hydrometallurgy followed the betterment of metal recoveries made possible by agitating finely ground gold ores in cyanide solution. Previously, the leaching of deslimed sandy pulps with cyanide solution had been done with porous-bottomed vats, not suitable for the new finely ground pulp.

It was in the early 1900's that active cyanide metallurgists began seeking better methods of continuous operation. Thereafter, until about 1912, new tools were intensively adapted to cyanide slime treatment. Pulp was prepared by the rake-classifier and the continuous settler invented by J. V. N. Dorr, and then filtered and the gold solution washed from the cake formed on the continuous rotary drum filter invented by Edwin L. Oliver. During this period the vacuum leaf filter, either of the Butters or the Moore type, became important, only to recede quickly to comparative disuse because of its discontinuous operation.

At first these new tools were used only in cyanide metallurgy. When flotation of base metal sulphides was introduced on a large scale at Inspiration, Ariz., in 1912, they found a new field. The froth was sent to thickeners and the dense pulp from these was dewatered on drum filters. Special uses for this group of equipment began to develop in other metallurgical branches, especially during the first World War. An example is the complex method used in producing electrolytic zinc.

In the booming 20's and the economical 30's, the use of this equipment spread in many process treatments. Each had been improved in design, but with its basic use remaining much the same as before.

Where will progress require hydrometallurgy to steer its course now? How can we make such a course practical? Will our stored-up fund of knowledge gained in past research be able to guide us on such an unknown journey?

Speaking soberly, we are really limited only by the unchanging laws of physics and chemistry, and within those limits we certainly can do what we must. Some of the "musts" that confront us, and only a few of them, may be mentioned here.

The hydrometallurgical plant of the future certainly will include some steps we do not now use, but those now used which will then be retained must perform their work faster, more effectively, more cheaply, and hence with smaller-sized units than those of today. The plant of the future will rely on a still wider use of automatic controls. Likewise, the curious actions of finely divided mineral particles, suspended in water or in aqueous solutions, will give easier and faster operation when their behavior is better understood. Such knowledge should improve the whole field of settling, filtering, and washing.

Repairs and replacements must become even more infrequent than now; although time now lost in such work is really a small item, it must continue to "approach zero as a limit."

If great advances in practice are to be achieved, this trinity will deserve the honors: first, basic theory, derived from natural laws; second, skillful engineering to design new machines; and third, new materials that may accomplish what former materials could not.

Our present-day materials furnish strength in compression and tension, resistance to corrosion under alkaline and acid conditions, as well as good electrical conductivity or, conversely, good di-electric properties. They include the alloys, rubber, glass in fibers and in sheets, synthetic fibers, and plastics. Concurrently, engineering practice and design are being, and will, be modified step by step to accommodate the use of these valuable new tools.

Lastly, basic theory under this changing complex of new materials, new engineering practice, and modified problems must be left to the inventors, who will surely provide for us the basic theory which that day may demand.

It is useless to specify this more closely. So long as solid particles in a liquid suspension are a necessary condition of process methods, just so long will separation and washing of these solids form a part of the problem. We believe it will be done by improved methods, but those improvements, as in the past, will form a step-by-step linking of the past with the future.

## IN RETROSPECT

**1900-2** Active metallurgists at this time, approximately, turned away from spitzkasten, decanter tanks, and plate and frame filter presses in search of better methods of continuous operation.

**1911** During the decade that ended approximately with this year the practice developed of applying the continuous drum-filter to filtering cyanidation pulp prepared by the rake classifier and the continuous settler. In the same period the vacuum-leaf filter became important for a time, only to lose favor quickly because of its discontinuous character.

**1912** The rake classifier, thickener and drum filter find use in connection with the flotation of base-metal sulphides at Inspiration, Arizona.

**1914-30** Continuously operating equipment for dewatering and washing find wider and wider application in process treatments, not only in other branches of metallurgy than those already cited but outside the mining industry as well. The respective designs of classifier, thickener, and filter remained basically the same, although they were constantly improved during this period.

VIGNETTES OF THE FUTURE

# Precipitation

**CHARLES W. MERRILL**
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PRESENT PRACTICE using zinc dust is a remarkably effective, cheap, and simple operation, and is the only process of which we have knowledge that holds promise of continued extensive use in the future. It is not without its problems despite its general excellence, but these are of a chemical nature rather than mechanical, resulting for the most part from precipitating solutions which are in an unfavorable chemical condition. We may expect to see precipitation improved by a more rational use of lime and the adjustment of other factors in ore treatment to produce solutions in better chemical condition.

Such adjustments need particular consideration when cyaniding ores, concentrates, or tailings containing substantial amounts of the sulphide minerals readily susceptible to attack by cyanide and lime, such as pyrrhotite or partially oxidized pyrite. The action of cyanide and lime on the sulphides produces sulphur derivatives which foul the solutions and result in well-known deleterious effects on the dissolution of the precious metals. The virulent effect of certain of these sulphur derivatives on precipitation, however, is perhaps not so widely recognized. Compounds containing sulphur in intermediate stages of oxidation, such as thiosulphate, are reduced by metallic zinc, forming sulphides which accumulate on the precipitate filter, coating the zinc and impeding the flow of solution. Clean-ups are consequently required at more frequent intervals, zinc is wastefully consumed, and the sulphide sulphur in the precipitate adds to melting difficulties. An increased cost of precipitation and melting results, and usually precipitation is less effective.

In such cases chemical preparation of the solution for precipitation should begin at the first contact of ore and solution, and continue all the way through the dissolving process. Strong cyanide solutions and long contact periods are conducive to the attack on sulphides, and these should be reduced in practice as much as possible considering effective dissolution of the values. Usually more important, however, are corrective measures in the use of lime alkalinity. The presence of any considerable concentration of lime during treatment, as when dry crushed lime is fed with the ore to the ball mill, greatly accelerates the attack on sulphide minerals. To avoid such excesses of alkalinity in contact with the ore, lime should be added piecemeal at critical points in the mill circuit and only in sufficient amount to hold the alkalinity at the minimum requirement. This may be just a trace of "protective alkali" in the grinding circuit to prevent loss of cyanide as hydrocyanic acid, or a slightly higher alkalinity in the thickeners to satisfy settling requirements. Some ores are well buffered and excellent results are being obtained in cyanidation with the customary "protective alkali" at the vanishing point. A circulating milk of lime system makes a convenient and practical method of adding lime piecemeal in the manner mentioned.

Difficulties in precipitation similar to those caused by imperfect clarification may result from the tendency of plant solutions to throw down insoluble compounds, such as hydrates of aluminum, iron, or magnesium. Trouble of this kind is frequently encountered when precipitating mixed solutions, as in conventional sand-leaching slime-agitation practice, or when solutions drawn from different sections or circuits of the ore treatment are mixed and precipitated. Mixing these solutions shifts chemical equilibria and induces deposition of insoluble compounds to take place. The reactions proceed slowly and if solutions are mixed directly in the clarifier tank, deposition of these substances continues to take place after the solution has passed through the clarifier. Hence these compounds accumulate on the precipitate filters and seriously impair the operation.

Where possible, solution circuits may be revised so that thorough mixing takes place before solutions are run to clarification, but it is not always practical to provide retention or storage capacity sufficient to allow the mixed solutions to stabilize before clarifying. A simple and effective method of improving the practice in such cases is to arrange the flow so that solution passes through the precipitate filters immediately and without rest after clarification, as in simultaneous clarification-precipitation. If the dissolved substances are derived principally from the mill make-up water, it may be advisable to condition the water with lime for removal of these salts before taking it into the mill circuit.

## IN RETROSPECT

**Zinc shavings were used for precipitating precious metals in the earliest cyanide plants. Zinc dust (condensed zinc fume) was soon introduced but was limited to batch operation until I developed at the Homestake a successful continuous process.**

**Introduction of Crowe's vacuum process for the mechanical removal of dissolved oxygen from solutions marked an important advancement in the art. Prior to this the elimination of dissolved oxygen, whether using zinc dust or shavings, was dependent entirely upon chemical action of the zinc.**

**Development of the simultaneous clarification-deaëration-precipitation process further increased the efficiency of zinc-dust precipitation by removing any opportunity for solutions to reabsorb oxygen after deaëration, or to throw down colloidal hydrates or other matter which cause pressure trouble in precipitate filters and impair the precipitation reaction.**

**The recently introduced precoat clarification, in which a precoat of filter-aid on the clarifier elements forms a medium capable of effective removal of the finest suspensoids, rounded out the development of the mechanical operations of precipitation to a high efficiency.**

VIGNETTES OF THE FUTURE

# Roasting

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DESULPHURIZATION is of three distinct types: hearth roasting, suspension roasting, and sintering. Appraisal of the art, through the years since metallurgical engineering became literate, requires discussion with respect to operations common to ores or concentrates of copper, zinc, and lead.

*Copper Concentrates*—Only when a matte of a given copper content is desired must one be exacting as to the calcine's sulphur content. Many methods of partial desulphurization have been used. In ancient times, copper oxide was sought to smelt with sulphide to produce copper. Later, sulphide ore was roasted in heaps, stalls, and hand-rabbled furnaces. In the last 50 years, mechanically rabbled furnaces have been used, operating generally without extraneous fuel. If the copper minerals are other than chalcopyrite, roasting may be unnecessary.

*Galena*—Desulphurization has progressed slowly. Difficulties in smelting finely divided, hearth-roasted ore in a blast furnace led to agglomeration by subjecting the calcine to a high temperature at the end of roasting. Roasting was long done in hand-rabbled, straight-line furnaces; later, in circular mechanized furnaces.

Advance in lead metallurgy was made in 1898 when Huntington and Heberlein developed blast roasting. Calcium oxide, carbonate, or sulphate appeared necessary at first, but later other substances such as exist in the gangue were found of equal value in absorbing excess heat.

In 1906, Dwight and Lloyd conceived that the action in the H. and H. pot was zonal; that the incandescent zone gradually rose from the bottom; that the cake was finished below; that there was active sintering in the incandescent zone, and above this the charge was stored until the sintering zone could reach it. The Dwight-Lloyd sintering process and machine resulted (this is dealt with in detail in another article on page 123).

*Zinc Concentrates*—Furnaces used for desulphurizing zinc ores or concentrates have been of the shaft, reverberatory, and muffle types. Some of their principles have been applied in the modern type. Thus, flash roasting makes partial use of certain principles of the Gerstenhofer or Stetefeldt furnaces. Hand-rabbled reverberatories changed from one long hearth to two or more, superimposed, which later became mechanized. From these came our circular multiple-hearth furnaces. The mechanical furnace has been similarly developed. Changes since 1800 have been gradual up to the early 1920's, when selective flotation caused a revolution in desulphurizing Previously, the Spirlet multiple-hearth and the Hegeler muffle furnaces and similar types had been used when sulphuric acid was to be produced. Improvements in capacity, calcine quality, and in hearth-roasting economy resulted from such changes as massive construction for heat conservation, circulation of cooling air through column and rabbling arms, and introduction of the hot air into the cooler zones. Furnaces so improved desulphurize 60 tons per day down to 3 percent.

Hearth roasters have been run autogenously when roasting down to 1 percent sulphur or less by distributing excess heat that is in the concentrate to hearths normally too cool.

Muffle roasters were abandoned because of inability to treat finely divided flotation concentrate. Double treatment has been substituted, consisting of a pre-roast in a multiple-hearth furnace, preferably autogenously, followed by sintering. In the Rigg method, the pre-roast desulphurizes to 7 or 8 percent; in the Baelen method to 2 to 4 percent.

Concentration of sulphur in the gas stream has been studied, with the idea of raising its tenor.

Developments in suspension roasting are of interest. Some companies in America and in Europe are using this method of rapid desulphurization. The roasters have capacities 100 percent and more above normal hearth roasting, using atmospheric air, and up to 500 percent with oxygen-enriched air. Quality of calcine has also been thus enchanced.

In general, desulphurization may see better heat distribution on roasting hearths and the cooling of hearths which normally run just below fusion. Oxygen-enriched air may be used more in suspension roasting. The future probably will see better methods of aggregating slime particles for sintering, deeper beds with thought to particle-size distribution, and tighter seals against false air leakage.

## IN RETROSPECT

**Heap- and stall-roasting were the earliest methods for desulphurizing heavy sulphide ores. Suitable for coarse lump ore or briquets carefully piled in pyramid form. Method still practiced in some places despite objectionable fumes and denudation of surrounding country.**

**Reverberatory furnaces were the first forms of inclosed roasting hearths. Originally they were hand-rabbled, but beginning with Spence's mechanization of the rectangular shelf furnace, various forms of mechanical rabbling were developed, applicable to various shapes of hearths—rectangular and round, single and multiple superimposed. O'Hara, Ropp, Edwards, Merton, McDougall, Evans and Klepetko, Herreshoff, Wedge, and others developed mechanically rabbled roasters. Brückner introduced the revolving cylinder.**

**Huntington & Heberlein originated blast roasting with lime, designated "lime-roasting" by Ingalls, and "pot-roasting" by Austin. Modifications of the Huntington-Heberlein process were introduced by Savelsberg, and Carmichael-Bradford.**

**Dwight & Lloyd developed continuous, thin-layer, blast roasting, or sintering, at Cananea, Mexico, for copper sulphide ores.**

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VIGNETTES OF THE FUTURE

# Sintering

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SINCE ITS INTRODUCTION IN 1906 the Dwight-Lloyd process has become firmly established as an important step in smelting lead, zinc, and other non-ferrous ores and lead-bearing materials. The physical character of sinter, its ease of reduction, the thorough elimination of sulphur, and, finally, the low cost of the operation have all contributed to the present widespread adoption of the process.

The next few years will probably see an increasing use of a byproduct of sintering—the sulphur in the gases. At a few plants this is now converted to sulphuric acid, but the practice is not common, partly for lack of a market for the acid and partly because of the dilute $SO_2$ concentration from the operation as ordinarily practiced. As markets develop, more plants will undoubtedly find it desirable to recover this sulphur. Then, more attention will be given to the gases and the operation will be adjusted to supply a highly concentrated $SO_2$ gas from the active roasting section of the machine, which will be taken off separately from the lean gases from the finishing end. These lean gases may be returned through a hood above the wind box if the value of the sulphur warrants or wasting it to atmosphere is objectionable. Uniformity of charge and avoidance of segregation, deeper beds and low air volumes, among other things, will be given particular attention to assure uniform, rich gases.

An important part of sintering in which improvements will be made is the preparation and handling of the charge to maintain uniformity of conditions so essential to good sintering. Where a single material is sintered, or where the several materials are all of the same physical and chemical character, preparation is relatively simple. But where materials of radically different size or composition must be treated together, a real problem is met, both in mixing and in preventing segregation in the feed bins or as the charge is fed to the pallets. Ingenious solutions have been presented in the way of mixing devices, but up to this time there is no one of a general character.

In the ferrous field the demonstrated advantages of sizing the ores and sintering the fines are so great that this practice will undoubtedly be extended. Smoother furnace operation, reduced coke consumption, and less flue dust more than offset the expense of screening and sintering. When flue dust, which carries more carbon than is necessary for the operation, is sintered by itself, the operation is slowed down because of the time required to burn out the excess carbon. A more profitable use of this fuel is to mix with the dust enough fine ore to bring the carbon content of the charge down to the required amount. This fine ore is sintered practically free of cost, because the fuel must be burned anyway. Thus the fine ore is agglomerated cheaply, so that less dust is made at the furnace, and also the excessive fusion of the sinter that occurs when high carbon flue dust is sintered alone is avoided.

A novel use for sintering, developed recently, is in the field of powder metallurgy. For many uses, a metal powder sized within definite limits is required, and it has been found that this sizing can often be done more readily on the oxide than on the metal itself. The metal in the form of scrap turnings, shot, etc., is sintered under special conditions to convert it to oxide; the sinter is ground and screened to the desired size and then reduced to metal. This is being done commercially.

Production of sponge iron directly from high-grade sinter is another interesting development. The cellular character of sinter promotes extremely rapid and complete reduction of the iron by reducing gases so that the output of a given unit is much greater than when treating concentrates or ore.

Separation of metals by volatilization-sintering will come increasingly into use. Ores of mercury and those metals forming volatile salts are readily so treated. In sintering zinc ores a large part of the cadmium and lead are volatilized, and with the addition of salt to the charge their separation is practically complete, so that a high-grade zinc metal can be made from impure ores with a cadmium byproduct.

In the metallurgical industry the practice of sintering will continue to expand, and possible new applications for this unique combustion process appear to be probable in other fields.

## IN RETROSPECT

**1906** Present system of roasting and sintering ores was developed by A. S. Dwight and the late R. L. Lloyd at Cananea, Mexico, for roasting copper sulphide ores. Applied a year later to lead sulphide ores in United States. Unique character of product, "pre-digested" for subsequent metallurgical treatment, solved problems in ore production and marked signal increase in efficiency of ore roasting.

**1908** First "straight-line" sintering machine, with its train of disconnected pallets, installed at Salida, Colo. Its mechanical principle is still sound. Other installations followed rapidly.

**1911** Sintering introduced in iron industry with construction of a plant to treat blast-furnace flue dust and fine ore at Birdsboro, Pa. Carbon functioned as fuel.

**1913** Sintering of Sudbury nickel sulphide ores was started.

**1920** Sintering of zinc ores spread quickly to the United States and Europe from Australia and soon became widely adopted. Double sintering of lead ores was developed.

**1930-40** Sintering extended to the non-metallic field.

VIGNETTES OF THE FUTURE

# Pyrometallurgy

## NON-FERROUS

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OUTSTANDING IN THE HISTORY of lead smelting was the development of sintering early in this century. Improvements in sintering technique and equipment and in blast furnace operation have gone hand in hand, until a single furnace now does the work of several furnaces 20 years ago.

Principles of zinc smelting have changed little. Use of sintering machines for final desulphurizing of concentrates has, however, largely replaced other roasting methods, and retorts and furnaces have been improved. Continuous furnaces have appeared, but the battle with the smaller intermittent retorts is not yet won.

Development of differential flotation for concentrating ores, since 1924 approximately, has had marked influence on non-ferrous smelting.

Principles of fire-refining of copper and lead have not changed, but operating methods have. Purer products are produced on a larger scale.

The metallurgical industry can take pride in the fact that it has continually taken advantage of the advancement in scientific knowledge and in total has spent large sums of money for research. There are many things to witness also that the dissemination of knowledge has taken place with considerable freedom.

Of particular interest are the laws of physical chemistry and thermodynamics, and some recent improvements in smelting and refining may be ascribed to their application. Combination of practical experience with sound knowledge of theory may produce radical changes in present practice.

Smelting of lead and copper ores has attained a high efficiency, but so much attention has been given to improving blast-furnace smelting for lead and reverberatory smelting for copper matte that little time and money have been available for a search for processes which may be radically different and better.

Production of lead should be approached from the viewpoint of pure galena, over 86 percent lead. Surely there must be a simple way for separating the lead and sulphur, recovering each in commercial form.

Perhaps the most serious criticism of present copper practice is our failure to use the full fuel value of the sulphur and iron in the concentrates. Roasting, reverberatory fusion, and converting have been developed as independent operations, and the efficiency of each has been improved. Here again we need to start with a clean concentrate and consider the best and cheapest way to extract the copper.

If the heat now lost in converting is to be made available to reduce the fuel cost, oxidation of sulphides will probably be the central feature of the future smelter rather than fusion in the reverberatory. Modification of present equipment to this end can be visualized.

In fire-refining cathode copper, continuous melting of cathodes and casting of finished shapes will probably take place without the present cumbersome oxidizing and poling operations. It is now done in electric furnaces. Careful atmospheric control should make it possible in fuel-fired furnaces.

The zinc industry has been one of the most secretive in pyrometallurgy. This has probably retarded its advance even though progress has recently been made. Certain fundamental laws of chemistry and physics also circumscribe zinc metallurgy and have kept development within narrow limits. Even within these laws there are variations in temperatures, pressures, and gas concentrations which when applied may result in better practice.

Oxygen-enriched air has its potentialities. Relatively cheap oxygen is now within the metallurgist's grasp, but he has been slow to utilize it. It can be a means for speeding up reactions, for obtaining higher temperatures, for operating with smaller gas volumes, and for promoting reactions which will not take place in normal air. Its use would probably cause radical changes in equipment, but it seems that these would in general tend toward simplification, and the net result would be important savings.

As to increased use of electrical energy, a beginning has been made in fire-refining of copper and in smelting roasted zinc concentrates. There are sound reasons for further applications. Possibilities for using low- or high-frequency induction furnaces in lead refining have been overlooked. Electric smelting by present methods seems to offer no special advantages over fuel firing. However, with new methods it may offer possibilities.

### IN RETROSPECT

**1866** At this time, smelting and refining of non-ferrous metals in the United States followed European practice and in many cases the plants were operated by European immigrants. The Welsh influence was dominant in the copper industry, the German in the lead industry, and both German and Belgian in the zinc industry. Ores were run-of-mine or hand-sorted, the furnaces small (15 to 50 tons of charge per day). Lack of scientific operation was noted by Anton Eilers, who, after a tour of the lead plants of the country, wrote in 1872 (*Trans.* A.I.M.E.: 1,380) "Continual and regular assays of ores, by-products and slags are almost unknown, so it is impracticable to ascertain, even approximately, the losses in smelting processes."

A succession of well-trained and competent men developed the industry along sound technical and economical lines to its present state of efficiency. In copper the little blast furnaces developed into the huge 87-ft. (long) furnace at Anaconda and then gave way completely to the reverberatory, which was more efficient in handling sulphide concentrates. The little intermittent reverberatories treating 10 to 15 tons grew slowly, then rapidly after fuel oil and pulverized coal became available, up to 800 tons of solid charge per furnace day.

VIGNETTES OF THE FUTURE

# Electro-winning

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IN REFINING COPPER, new plants have installed the multiple system, and this will continue for the normal type of operations. Tank arrangement is likely to be the Walker, with cells set side-to-side and consequent saving in busbar copper, or the Whitehead contact on side-to-side tanks. Tanks will usually be of concrete with antimonial lead or asphaltic base lining, and possibly cast in unit blocks. Anodes will generally be cast from anode furnaces, with continued effort to raise their grade. Purification of the electrolyte will also tend to increase and, with greater purity of anodes and electrolyte, anode spacing will be lessened. Current density will be as high as the cost of power and precious-metal content permit, with a general range between 15 and 30 amp. per square foot of cathode surface. In electro-winning, tank-room trends will be like those given. The insoluble anodes are likely to be antimonial lead, unless nitrates prevent, or such lead alloys as will make for purer cathode copper. Current density will be as high as power cost allows with a tendency to be over rather than under 10 amp. per square foot. For voltages above 250, ignitrons will be serious competitors of motor-generator sets and converters.

Efforts will continue for making alumina from raw materials other than relatively pure, high-grade bauxites. Concurrent production of salable byproducts offers the most promise of offsetting the present higher costs. Recovery of aluminum by processes similar to those used for copper, lead, or zinc does not appear in the offing. Where tonnage permits, the trend toward larger furnaces will continue, making for more constant operating conditions. With larger cells, holding furnaces can be operated to better advantage and greater uniformity of metal obtained. The theoretical voltage required to reduce alumina is 2.8 volts; that required in good practice is 2 to 2½ times this figure. There is therefore a margin to work on for lower cell resistance and smaller losses between the cell and the d.c. source. These have been cut in the newer plants, with power consumption reduced below 10 kw.-hr. per pound of metal. The mercury arc rectifier is the logical conversion equipment.

Electrolytic refining of lead is confined to a lead fluosilicate electrolyte. Operations have been standardized and operating details improved. Mather's work covers the possibilities of other electrolytes, the most promising being perchlorate and fluoborate solutions.

Magnesium is obtained by electrolysis of a fused bath using either anhydrous magnesium chloride or oxide. Operating results to date favor the former. The intensive work on the latter may improve its relative efficiency.

Electrolytic manganese has progressed to the pilot plant stage, with production of about 1 ton per day. Much of the dissolved manganese is oxidized and precipitated in the cell, requiring releaching. Anodes of the Fink-Kolodny type have a field in reducing this undesirable reaction.

Electrolytic refining of nickel does not separate cobalt and it competes with the carbonyl process, which also recovers the precious metals. The latter process requires a profitable market for the copper sulphate produced.

A process somewhat similar to that developed by the American Smelting & Refining Co., using sulphuric acid with cresol-phenol sulphonic acid as the electrolyte, will produce high-grade tin from comparatively impure complex concentrates at a moderate cost.

Zinc electro-winning will continue to use a sulphate solution, with lead-lined concrete or Prodorite cells. A lead-base anode, less expensive than the lead-silver alloy used to keep the lead content of cathode zinc at a minimum, would be desirable. Maximum purification of solutions will continue and current densities will be as high as power costs permit, with a general range in the thirties. Work has been done on the effects of single impurities, but it is the combined effect of two or more that is a major factor in zinc work. This effect is quite different than additive predictions would indicate. A relatively small plant of, say, not over 10,000 tons of metal per annum, which can operate at normal prices in countries where average labor rates prevail, is a desired unit. Mercury arc rectifiers or ignitrons will be most difficult competitors for the older conversion machines. Electrolytic refining of spelter using sulphate electrolyte is metallurgically successful, but it is normally restricted to periods of unusual demands.

## IN RETROSPECT

**1833** Faraday's researches lead to his presentation of the two basic laws of all electrolysis.

**1865-71** Electrolytic refining of copper as set forth by the Elkington patents is made practical by the development of the electric dynamo. The first refinery in the United States was the Balbach-Thums, Newark, N. J. (1883 to 1918). It pioneered in copper, silver, gold, and nickel.

**1886** Hall produced aluminum by electrolysis of a fused electrolyte—alumina dissolved in molten cryolite. Heroult came out with somewhat the same process about the same time.

**1902** Anson Betts patented the only lead electrolytic refining process, which remains in large-scale operation. Hydrofluoric acid acts on silica to form hydrofluosilicic acid, which in turn reacts with lead to form the electrolyte—lead fluosilicate.

**1915** Anaconda and Trail start commercial electrolytic zinc plants using a sulphate electrolyte to recover zinc obtained from bulk flotation concentrates. Bulk flotation developed into selective flotation and electrolytic zinc plant treatment of zinc concentrates spreads over the world.

VIGNETTES OF THE FUTURE

# Lubrication

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SPURRED ON BY THE DEVELOPMENT of the automobile, an awakening occurred generally in industry as to the importance of correct lubrication and its effects on production and maintenance costs. The mining industry has been no exception. Machine designers, also, became lubrication-conscious and began to employ, in part, at least, some science in the design of bearings and the application of lubricants. Seals and inclosures or housings have been provided in most designs to protect bearings and gearing from the harmful effects of dust, grit, and water. This has been an important improvement, especially in the mining industry, for mining equipment operates generally under adverse conditions. Abrasive dust is nearly always present, mine water is generally corrosive and full of abrasive grit, and conditions usually are severe.

Although there are still opportunities for improvements in the design of lubricating systems and methods of application to much of the modern equipment, yet the design from the viewpoint of lubrication is far ahead of the lubricating practices of operators. In all too many operations there is virtually no system or organization established and charged with the responsibility of lubrication. Lubricants are frequently purchased haphazardly and handled and applied in a like manner. Waste is often appalling. Too often, oil and grease drums are set in the most convenient dark corner or left in the open with lids off and bungs out, thus exposing the lubricant to all sorts of contaminating substances. Containers for dispensing lubricants often never receive the benefit of a periodic cleaning. The best oil ever refined is useless if it is stored and handled carelessly. Even a little dirt and contamination will impair the lubricating quality of an oil or grease and take its toll in excessive wear, loss of power, and perhaps even a destroyed bearing or gear.

Correct lubricants must obviously be chosen and correctly applied. It is no exaggeration to say that today's lubricants are better and more securely packed than those of even a few years ago. New and more exacting and scientific refining processes are being employed by the refiner; greater care is exercised to make more certain that containers are thoroughly clean before filling. The reputable refiner makes every effort to supply the consumer with clean products especially suitable for his purposes. This is obviously the end of the refiner's responsibility and authority. But, on the other hand, it is the beginning of the responsibility of the user, and the efforts of the refiner go for naught unless the user properly handles and applies the lubricants.

It is encouraging to note, however, that a few operators have awakened to this state of affairs and have put into operation efficient control of lubricant from purchase to application to the machines. They have built well-planned and adequately lighted oil-storage houses or rooms; installed efficient storage tanks, handling equipment, and measuring devices; and set up forms and records for controlling lubrication distribution and schedules of applications.

Efficient equipment for handling, dispensing, and applying lubricants, especially designed for mine service, is available. For example, mobile, electrically operated grease pumps, that can be plugged into outlets on the power lines or electric locomotives, are built. These aid in supplying grease to the bearings and avoid contamination of the grease. Some modern greasing equipment automatically limits the amount of grease applied to bearings, thus guarding against over-lubrication. This feature is particularly desirable for ball and roller bearings, which will overheat if packed too full of grease.

As the mining industry is now extensively mechanized, the most pressing and possibly the most likely improvement to be made in the near future from the standpoint of lubrication is in the purchasing, storing, and handling of lubricants by the operators. There will probably be less "price lubrication" and more buying of lubricants to meet the requirements of the machinery. Undoubtedly, manufacturers will continue to improve methods and systems as applied to their equipment. In this connection, we may look forward to the use in the future of centralized greasing systems, such as those that are now widely employed in the steel, paper, textile, and other industries.

## IN RETROSPECT

**1600-1700** Not until beginning of seventeenth century, when Newcomen built the first successful steam engine and operated pumps in English coal mines, was the mining industry concerned with lubrication. Nearly 100 years later Watt produced his engine, also first used to drive mine pumps and then hoists. The mining method remained unchanged until 1860.

**1860** Air drills were first put into use.

**1880** Prior to this date various vegetable, fish and animal fats, and oils served as lubricants.

**1883** Petroleum lubricants begin to receive attention.

**1886** Reynolds demonstrates mathematically that lubrication is a hydrodynamic problem depending on viscosity of lubricant.

**1889** The electric mine locomotive was introduced. These early machines presented no especially difficult lubrication problems. Speeds were low, clearances generous, and loads low or moderate. All parts were hand-lubricated.

**1900** Practice still rule-of-thumb. Petroleum lubricants have displaced animal and vegetable oils and fats.

VIGNETTES OF THE FUTURE

# Health and Safety

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THE TREND OF THE PAST TWENTY YEARS, more particularly the past ten years, has been definitely in the direction of marked improvement in both health and safety in all phases of mining, compared with the conditions of the earlier day. Though the feverish activities resulting from the defense program are likely to interrupt this trend, there is no indication that the effect will not be favorable, at least in the long run.

At no other time in the history of the industry, however, has there been so much hazard in trying to prediet what is ahead of us in mining, more particularly in the domain of health and safety. The present preparedness program for metals and minerals introduces complications.

Health and safety activities in mining were long considered as of doubtful feasibility, utility, or necessity, and this was definitely true until about 1910 or 1912, even though mining safety laws were in effect in most of the mineral-producing States. Numerous occurrences or conditions, however, around 1910 and subsequently have aroused a certain safety consciousness, these including, among others, the establishment of the Bureau of Mines in 1910 and of the National Safety Council in 1921; the passage of numerous State compensation acts from 1910 to date; and the safety provision in the N.R.A. in 1933, which had a vital influence even though the act was later declared void. The greater interest in health and safety shown recently by labor organizations is indicated by the inclusion for the first time of a provision for safety committees in recent wage-scale negotiations between coal mine operators and workers.

Special studies have shown beyond doubt that accidents under present-day conditions, coupled with the high premiums for compensation, as well as other expenditures due to accidents, now constitute a material item in cost of production, some authorities placing the amount as high as 10 percent of the total cost. This is of more than ordinary concern to some types of mining because the margin of profit (if there is any profit) is frequently much less than 10 percent of the cost and in numerous cases the elimination or the reduction of the approximately 10 percent of cost due to accidents would convert a red balance to one in the black. When it is further realized, as has been established by numerous investigations and studies, that by reasonably well-planned and coordinated safety procedures this cost due to accidents can be reduced to 1 or 2 percent or even less, and that usually the added safety increases efficiency and thereby further depresses costs, the well-informed operating executive learns that his organization cannot afford to try to operate without appreciable attention to health and safety.

The humanitarian motive should be enough to cause persons in all types of industrial or social activity to be intensely in favor of anything which will reduce the occurrence of accidents or ill health. Human nature, it is true, is not so constituted as to keep to the front at all times such high-minded principles. However, the mining industry stands to gain such definite advantages from the efficiency and cost viewpoints that it is almost certain that accident occurrence and ill health in industrial work will be held to a minimum.

The present emergency is going to take a heavy toll of the country's reserves of minerals and metals. If it continues, it is likely to force recourse to the poorer deposits, which in turn will bring about a higher degree of mechanization wherever possible. Here will be an excellent opportunity for a further reduction in the occurrence of both accidents and ill health in mining industries than they have yet managed to achieve. Though mechanization has its own hazards in respect to safety and health, almost invariably when these are studied and a determined effort is made to overcome them, the ultimate result is improved working conditions. There is reason to believe, therefore, that long before another fifteen years have passed the accident rate as well as the amount of ill health in the mining industries of the United States will be reduced by at least half below present rates and levels. The groundwork to aid in accomplishing this has been well laid; the trend is definitely in the direction indicated. About the only way in which failure could occur would be through influences connected with present world turmoil completely overturning our present mode of thinking and living.

## IN RETROSPECT

**1878** Hospital for the care of victims of mine accidents was established in Montana.

**1902** Maryland gets first workmen's compensation legislation.

**1907** Anaconda Copper Mining Co. first company to provide rescue breathing apparatus at its mines.

**1910** U. S. Bureau of Mines organized. Begins safety work.

**1914** Bureau makes first investigation of respiratory diseases.

**1916** Joseph A. Holmes Safety Association founded.

**1917** Goggles were introduced into mines for prevention of eye accidents. Safety hats two years later.

**1918** California State Legislature enacts provision for compensating occupational diseases.

**1929-32** Utah Copper open pit worked 11,000,000 man-hours without fatality.

**1940** All States but one have workmen's compensation laws.

VIGNETTES OF THE FUTURE

# Mining Education

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THE FIRST REALLY SUCCESSFUL ATTEMPT to provide mining education in the United States antedated the founding of the *Engineering and Mining Journal* by only two years. In Europe such education had been available for more than a century, and American youths had been studying in these European schools since 1794. It was natural, therefore, that curricula here were patterned after those there developed, although their main objective was to train officials for a government-controlled industry, though government control of the mineral industry here was still far in the future. Actually it made little difference, because the preceding century had been one of rapid advance of scientific knowledge, which the schools had begun to teach, albeit in the face of strong opposition from those who maintained that the classics were the only proper career of a scholar. The mining schools were important centers for the teaching of natural science, as well as of the actual techniques of mining and metallurgy; the applications of science to the improvement of old techniques and the development of new were not yet standardized, and could not be, since they were in process of constant change.

Mining education in the United States therefore also consisted of the teaching of the sciences, especially mineralogy, geology, chemistry, and mechanics, and of the practical techniques of mining and metallurgical operations. The applications of chemistry and physics to metallurgical operations have steadily and rapidly progressed and metallurgical graduates of 25 years ago would be as much or more embarrassed if required to answer the examination questions propounded to undergraduates today as electrical or mechanical engineers of the same vintage would be. The applications of geology and mineralogy to the problems of the mineral industry have involved much less development of basic theory, while mining continued to be largely a study of the steady improvement of mechanical equipment suitable for underground and surface work.

Almost 50 years ago Edward Orton, Jr., who had succeeded his father as State Geologist of Ohio, initiated education and research in ceramics at the Ohio State University. At first little more than the application of chemical principles, it soon included basic engineering instruction and the granting of the degree of engineer of mines in ceramics. Out of this there eventually evolved a definition of ceramic engineering as the mining and processing of non-metallic minerals (other than fuels) and a recognition by the ceramic engineers that their original association with mining engineering was a sound concept.

Some 25 years ago Roswell H. Johnson, at the University of Pittsburgh, pioneered in engineering education for the petroleum industry. The movement spread, basic theory was developed, and we now have petroleum production engineers who know what a three-phase diagram (oil-water-gas) is, and what its significance is in the practical job of getting oil out of the ground. About ten years ago my colleague, Professor Bucky, pioneered in the application of mechanics to the study of underground mining operations. This has since come to be known as barodynamics and opens the way to a similar application of basic theory to the many and varied problems of deep mining.

In so far as anyone can forecast the future, mining education is today on a more secure basis than at any time in the past seventy years. Mining geology is holding its own, metallurgy has made such advances that even the inroads of the chemical engineers on the side of production metallurgy, and of the mechanical engineers on the side of the application of metals to engineering purposes, have still left it an enormous territory that is peculiarly its own. Mining engineering is developing a field which no other type of engineer is qualified to occupy; and it seems safe to prophesy that the administrative as well as the technical direction of mineral enterprise will come more and more into the hands of those who have had an engineering training for such responsibilities.

Mining education is not a mere branch of general engineering education; it is both wider and deeper. It seems destined to increase in importance, rather than diminish, until every aspect of mining and metallurgy is in the hands of a trained technologist.

## IN RETROSPECT

**1824** Engineering education in the United States begun at Rensselaer Polytechnic Institute, Troy, N. Y.

**1853** The first curricula leading to degrees in mining and metallurgical engineering initiated at the Polytechnic College of Pennsylvania, Philadelphia.

**1864** The first School of Mines in the United States established in connection with Columbia College, New York, through the activities of Thomas Egleston, who became professor of metallurgy and mineralogy.

**1894** Ceramic engineering education initiated at Ohio State University by Edward Orton, Jr.

**1914** Department of oil and gas production established at the University of Pittsburgh.

**1930** Barodynamic study of mining operations initiated at Columbia School of Mines.

**1941** Curricula leading to bachelor's degrees in some branch of mineral industry education offered by 55 academic institutions in the United States.

VIGNETTES OF THE FUTURE

# Mineral Dressing Education

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THIRTY-FIVE YEARS AGO instruction in ore dressing comprised one or two lectures and one laboratory period per week for a year (or the equivalent thereof) and was offered to students of mining and metallurgical engineering. From the viewpoint of the instructor the time allotted was ample; he was forced into considerable repetition of the real meat of his knowledge, if he desired to fill out his sixty hours of talking time without padding with descriptions better expressed in text books and catalogs. He confined himself largely to metalliferous ores, with apologetic mention of the lick-and-a-promise given to anthracite. As to most of the basic procedures described, he was fortunate if some student didn't break in with comment to the effect that a similar discussion appeared in *Agricola*. From the viewpoint of the student this limitation of coverage seemed logical and right.

Today both mining and metallurgical engineering students still devote the same little dabs of time to ore dressing, but now they get the veriest skimming of the knowledge available, and graduate babes-in-arms so far as understanding of the technology of a modern concentrating mill is concerned. Both are still happy, from their separate viewpoints, to leave non-metallic minerals vaguely to the farmers, or the ceramists, or the chemists; both are now afraid of petroleum because it has something to do with organic chemistry. Their attitudes are not greatly different from those of their instructors. The result is that a great field of professional activity, the dressing or beneficiation of the crude-mineral crust of the earth, which employs the same principles and many of the same procedures irrespective of the type of crude, is now split up among a half a dozen different kinds of engineers, no one of which has special training for the job.

Columbia University, recognizing the need and opportunity that here exist, has offered an integrated course of studies in mineral dressing leading to an appropriate degree. Mineral dressing, as therein defined, does not mean simply ore dressing rechristened. It comprises rather a group of technologies now sub-grouped in part under the names ore concentration, hydrometallurgy, pyrometallurgy, washing of non-metallic minerals, lime burning, cement manufacture, harvesting of brines, petroleum refining, etc.; in other words, the treatment of mineral crudes to win or make those primary derivates thereof which are the materials of consumer use.

The tests of a technical curriculum are: whether it can be learned by the average student; whether it supplies him with salable mental skills; the breadth and stability of the market for such skills; and the value of experience in the practice of these skills.

The new curriculum requires no more chemistry, physics, or mathematics than is now required of students in chemical engineering, nor any greater number of technical courses than are now prescribed to students in other branches of engineering. It permits at least as thorough study of each subject as is made of subjects of equal magnitude in other engineering curricula. It provides for more complete study of ore dressing, the treatment of industrial minerals and rocks, and petroleum refining than is now possible in existing curricula for mining, metallurgical, and chemical engineering. This would seem to dispose of the question of learnability. Technical graduates less specifically trained now direct the operations of all dressing plants; hence such skill is of proved salability. The graduate's market is the entire mineral industry, amounting to many billions of dollars of production annually; the whole industry has never collapsed at once, not even at the height of the New Deal boom. These facts demonstrate breadth and stability of market. The value of experience is more difficult to demonstrate without extensive analysis and comparison of the operations involved in the various methods of beneficiation. It is of my knowledge, however, that the professional activities of one consultant over the past fifteen years have been about equally divided between ore dressing, petroleum refining and hydrometallurgy, with occasional sorties into lime burning and cement manufacture. In so far as such knowledge is a basis for judgment, it has indicated that much of this engineer's value as a consultant has lain in his recognition of parallels in the different fields, and in applications of the solutions of one to the problems of the other.

## IN RETROSPECT

**1556** "De Re Metallica," by Georg Agricola, the first systematic compendium of knowledge of minerals, their occurrence, extraction, and dressing, was published in Saxony. The author was a doctor of philology, a practising physician. The English translation of Agricola, by Herbert and Mrs. Hoover, should be prescribed reading for blind worshippers of modern technical achievement.

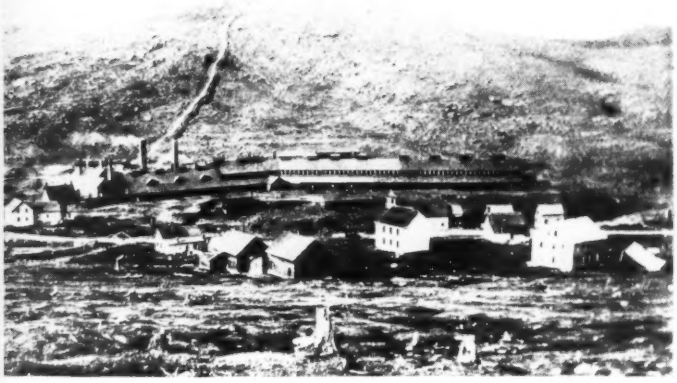
**1765** The first mining school was founded at Freiberg, Saxony. For more than a century Freiberg was a center of instruction comprising a happy blend of general science and traditional technology.

**1893** "Ore Dressing," by Robert H. Richards, professor of mining at Massachusetts Institute of Technology, a keen experimentalist, a great teacher, and a lovable and inspiring gentleman, appeared. This book, and Professor Richards' teaching, brought to ore dressing the attitude of experiment, replacing the practice of blind following of precedent that had previously prevailed. To one who has lived through the tremendous modern advance in the art, "Richards" played as large a part as Wilfley, Hardinge, Dorr, and the coterie who developed the modern froth-floation process.

# Old-Timers

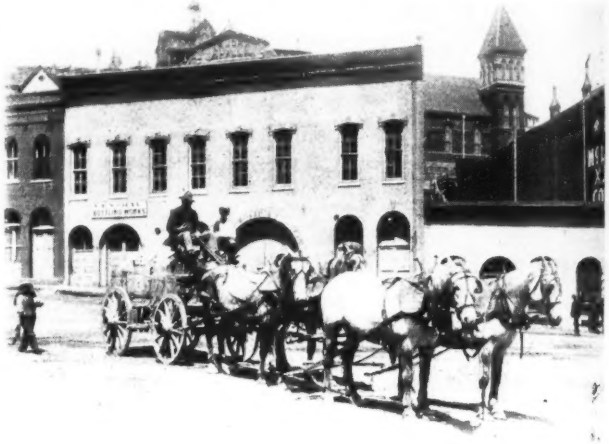
**Views of early Western mining scenes contributed by *E.&M.J.* readers**

**Little Pittsburgh mine, Fryer Hill, Leadville, Colorado, about 1879-80. From an old stereoscopic view, courtesy of J. Wells Smith, Los Angeles, Calif.**

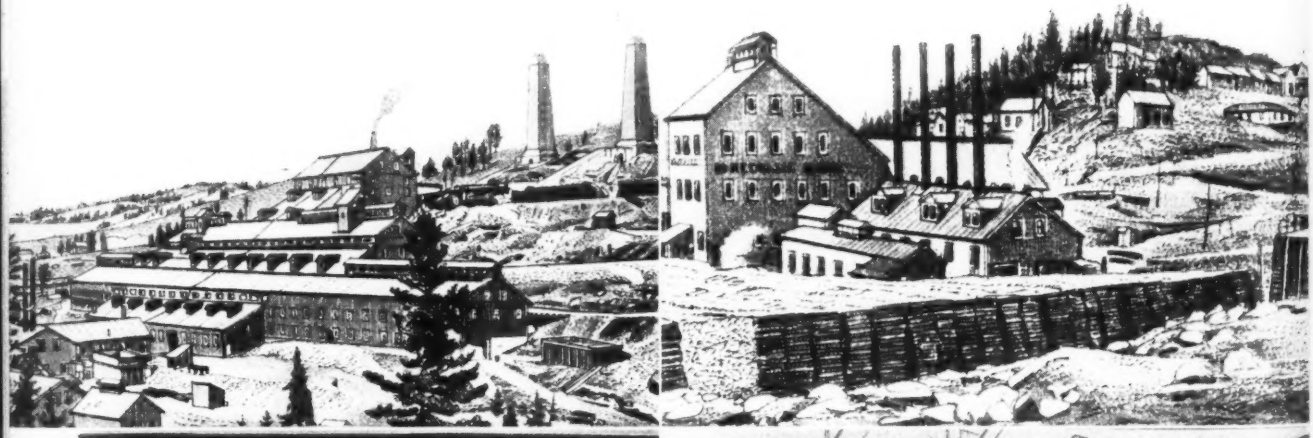


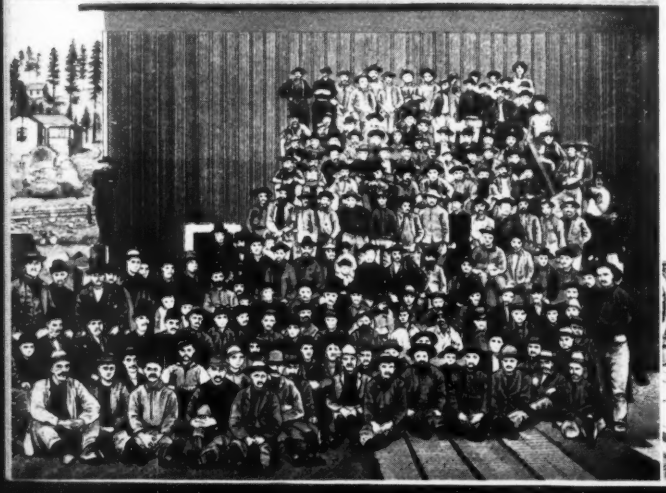
**Old copper smelter at the Ely mine (Copperfield), Vershire, Vermont. The long building houses about 20 brick blast furnaces. Flue for smelter gases runs up the hillside. Courtesy of George A. Packard, Boston, Mass.**

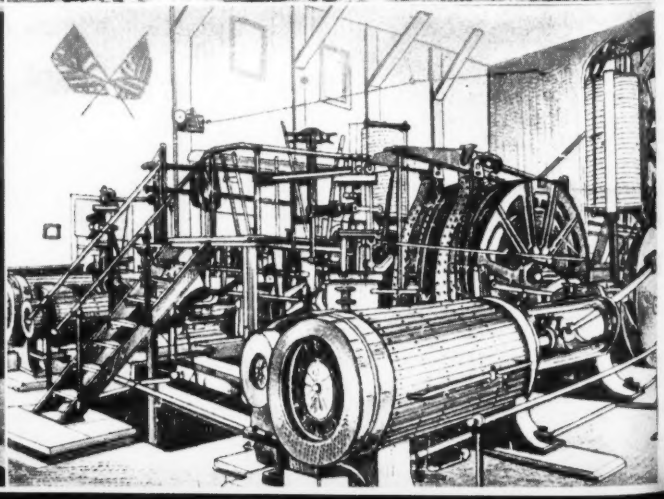
**Below: Typical quartz wagon and team, Central City, Colorado**



**Below: Bi-metallic mill, mine, crew, and hoist. From an old album of views of Granite and Philipsburg, Montana. Courtesy of J. H. Jonte, Stockton, Calif.**

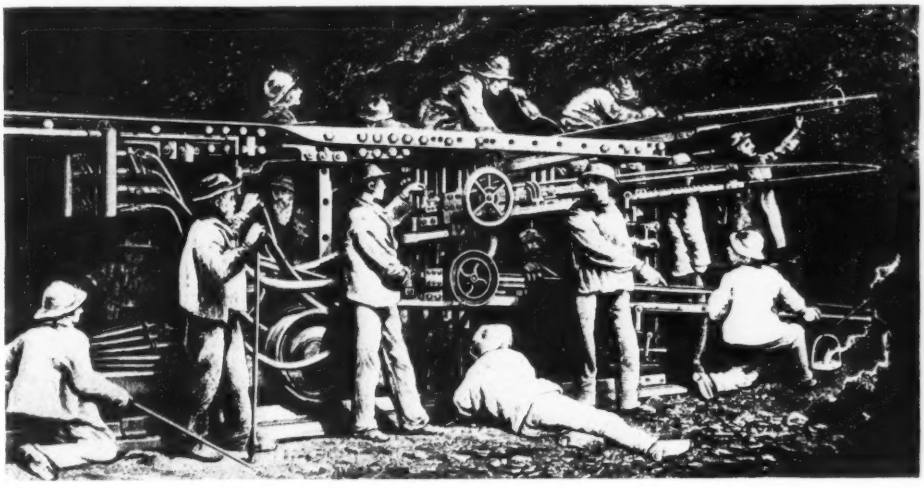






Right: Sinking the first shaft, 1885; and the ore trestle from shaft to railroad, 1886, Sunday Lake mine, Gogebic Range, Michigan. Courtesy of J. Wells Smith, Los Angeles, Calif.

One of the last of the Chinese river miners, California. P. Burch, Seneca, Calif.

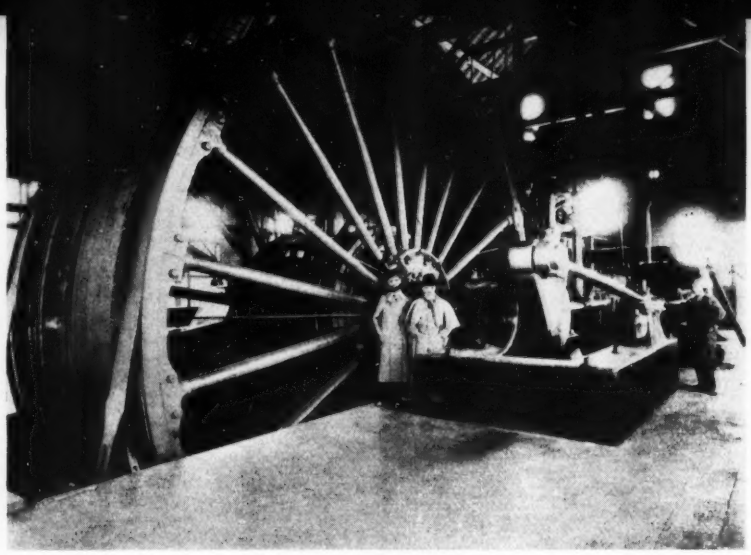


Right: First large installation for compressed-air drilling, Mont Cenis tunnel under the Alps, about 1861. The Bettmann Archive, New York

Miner Street, Yreka, California, in 1851, just below Yreka Flats, where gold was discovered by Abraham Thompson. Tent at left was general store of Churchill & Company. Two-story building on right was Morning Star Hotel. The photo on the left shows Abraham Thompson (right) working discovery claim on Yreka Flats. Courtesy Minnie G. Hearn collection

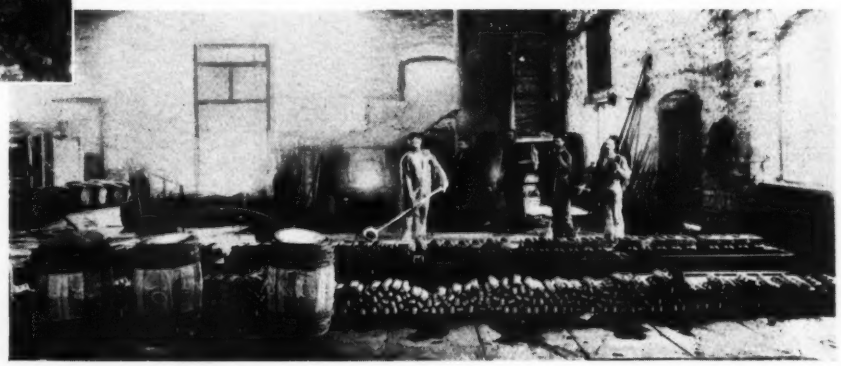
Left: Morning scene in Idaho Springs, Colorado, about fifty years ago

Below: Double-jack drilling in the Tamarack workings in the Copper country. Right: One of the huge pieces of equipment that long marked operations in the Copper Country: Tamarack No. 2 hoist

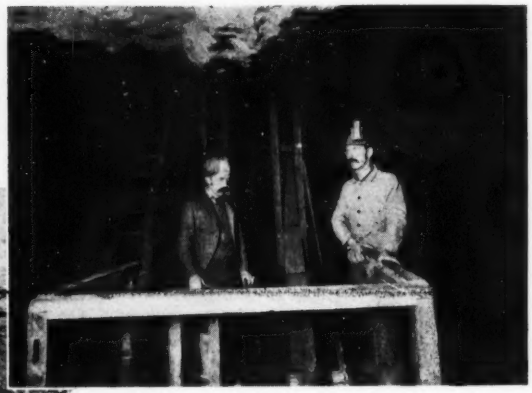


# Old-Timers

(Continued)

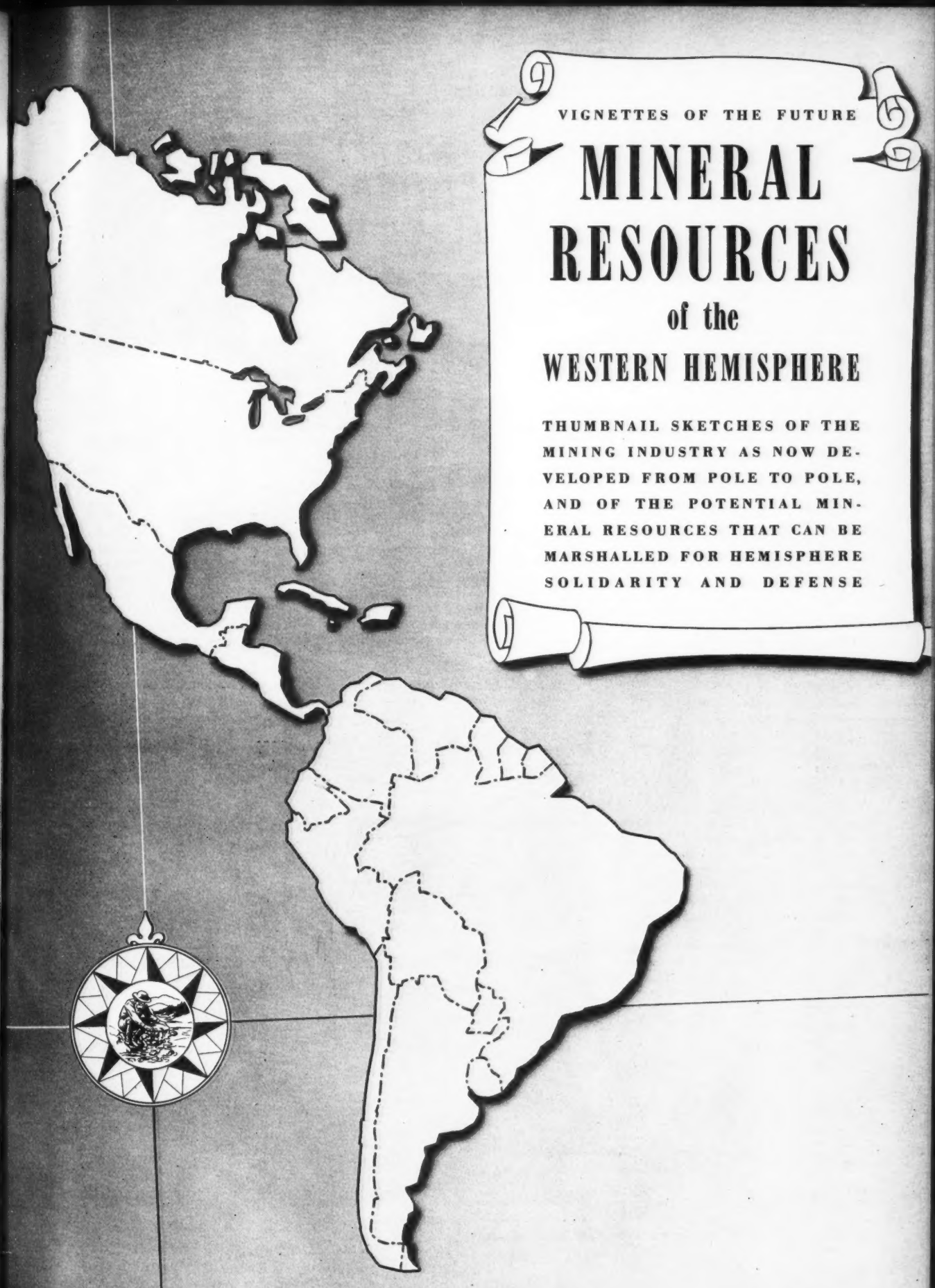


Casting ingots of refined copper at the Dollar Bay smelter on Torch Lake. Left: The jig floor in the Atlantic mill in the Copper Country. In the foreground are kieves used in cleaning the concentrate



Two views of the Cornish man engine at the Quincy mine in the early 'nineties. By moving from platform to platform a miner could save his legs and breath in going up or down the shaft. Above, another view of the man engine in the Quincy mine. At the left Dr. L. L. Hubbard, Assistant State Geologist of Michigan in the 'nineties. At the right, F. F. Sharpless.

All photos on this page
courtesy of Frederick F. Sharpless



VIGNETTES OF THE FUTURE

# MINERAL RESOURCES

## of the WESTERN HEMISPHERE

THUMBNAIL SKETCHES OF THE MINING INDUSTRY AS NOW DEVELOPED FROM POLE TO POLE, AND OF THE POTENTIAL MINERAL RESOURCES THAT CAN BE MARSHALLED FOR HEMISPHERE SOLIDARITY AND DEFENSE

VIGNETTES OF THE FUTURE

# Arizona

**T. G. CHAPMAN**
*Director, Arizona Bureau of Mines*
*Tucson, Arizona*

## IN RETROSPECT

**1863** Lode and placer gold discoveries in Prescott, Oatman, Wickenburg, and other districts influenced Congress to make Arizona a territory.

**1873** Adobe furnace at Clifton produced black copper, hauled by ox teams to railhead, Independence, Kansas.

**1881-82** Dr. James Douglas became associated with Phelps Dodge and Company, marking the beginning of his great constructive influence in the copper industry and the Southwest.

**1892** Cyanide process introduced in Yavapai County.

**1907** Development work at Ray by L. S. Cates under D. C. Jackling marked beginning of development of large low-grade porphyry coppers of Arizona.

**1916** Arizona produced approximately 45 percent of United States' and 23 percent of world's copper.

**1917** Large-scale production of copper by leaching and electrolysis at Ajo.

**1937** Phelps Dodge Corporation decides to develop Morenci orebody by open-pit mining, concentration, and smelting.

ANY PREDICTION of the future of the copper-mining industry in Arizona depends on many unpredictable factors in addition to ore reserves. Although some copper mines have been worked out and parts of some of the larger districts have been seriously depleted, none of the large districts has been exhausted.

It must be recognized, however, that it is becoming more and more difficult to develop ore as rapidly as it is extracted, and that much of the gain in ore reserves over the past 25 years has been due to including lower-grade material as a result of advances in mining and ore treatment.

Some of the larger copper properties are in a favorable position with respect to margin of profit under current conditions; others find it difficult to maintain a reasonable profit. It is these marginal mines that cause some concern in Arizona.

One of the favorable factors for maintaining Arizona's position in the copper industry is the development of the open-pit orebody at Morenci. It is significant that the Morenci district, oldest from the standpoint of important production, now ranks first in potential future production. Morenci has produced approximately two billion pounds of copper to date and is expected to add another five billion pounds from the open-pit orebody which is expected to go into production early next year. The known reserves of this orebody represent approximately 30 percent of all copper produced in Arizona to date.

Gold and silver follow copper in importance, accounting for about 12 percent of the total value of past production. On the average, about half of the gold and silver production in Arizona is derived from copper ores.

Total lead and zinc production of Arizona has amounted to about $48,000,000. It is not likely that the annual production of these metals will increase greatly in the future.

There is some production of molybdenite from copper ores, but it has not been as important as in other copper districts. There is also some production of wulfenite and molybdenite from ores other than copper.

There are many occurrences of tungsten in the State. Although development has not proceeded far enough to give a prediction for the future, it is likely that some producing mines will be developed from known prospects.

The relatively large deposit of manganese near Artillery Peak gives some promise of production, although it will very likely not be low-cost manganese.

Vanadium occurs in southern Arizona as lead and zinc vanadates, from which it has been recovered. Uranium-vanadium ores, similar to those mined in Colorado and Utah, are known to exist in northern Arizona.

Several deposits of quicksilver have been productive and will probably continue to be for a long period if the price for the metal is favorable.

Arizona's chrysotile asbestos is considered a superior product for electrical insulation purposes. Fluorspar, feldspar, bleaching clay, diatomite, and other non-metallics are growing in commercial importance.

**Known reserves of open-pit orebody at Morenci are equivalent to 30 percent of all copper produced to date in Arizona**

# California

**WALTER W. BRADLEY**
*State Mineralogist*
*Division of Mines, San Francisco, Calif.*

PETROLEUM, accounting for from 60 to 70 percent of the State's annual mineral value, and gold in second place with 14 percent, are but two of California's "57 varieties" today so far as her mineral industries are concerned. The list is longer and more diverse than that of any known similar area of record. The groups of the fuels, metals, structural materials, industrial (non-metallic) materials, and salines are all well represented. It is true that production in some substances amounts to only a few hundred dollars' worth a year, but the list is long and with many of important economic interest.

Distance from, with high transportation costs to, centers of large population and industrial consumption have held back commercial development and utilization of many of California's minerals of potential value. With the necessities of the current national defense program for certain critical materials, both for immediate use and for stockpiling, some of this State's minerals become of particular importance. Probably the outstanding of these is quicksilver. Present prices, more than double those of September, 1939, at the beginning of the European conflict, have stimulated production at the then operating mines, have stimulated search resulting in finding new deposits and orebodies, and have made possible the reopening of mines idle for many years. California is the leading domestic source of this metal, as well as of gold, which too has been activated by a higher price, today's $35 per fine ounce as against the historic $20.67 of the previous 100 years.

Tungsten is another strategic mineral which California contributed in 1915-1918 and is again to the fore with in the present crisis. Ore-dressing facilities are being greatly expanded, and combined with the products of Nevada and Colorado, the United States will soon be independent of foreign sources, if not already practically so. Others on the strategic materials list include chromite and manganese ore, the former already beginning a resumption of shipments which ceased after the 1915-1918 period of activity. Manganese seems to be slower in getting under way. The future seems to offer improved possibilities for these ferro-alloy metals on the Pacific Coast with the completion of such large hydro-electric power plants as those at Boulder Dam, Grand Coulee, and Bonneville, and Shasta Dam to come. Already one large nationally-known company has reported plans to build a plant for ferro-manganese and ferro-chrome at Portland, Oregon.

California is the principal world source of borax, thanks to the kernite deposits of Kern County and to the brines of Searles Lake. The latter, along with the bedded deposits of Carlsbad, New Mexico, is also contributing to our new domestic independence of Europe for potash.

Aside from the effects of war-stimulated activities in our mineral industries, outstanding growth in the last twenty years in California has been evident particularly in the non-metallic or industrial minerals group. This has been due in part to establishment of consumer-industry plants here, utilizing local raw products. The future offers many other such possibilities.

**Development of the gold dredge to its present high capacity and efficiency is a feature of Californian accomplishment**

## IN RETROSPECT

**1849** Gold mining was the predominant mineral industry in California up to 1907, when it was overtaken in annual value by petroleum. Quicksilver mining was practically coincident with gold. Copper ore shipments began in 1861.

**1865** Gold production up to 1885 was marked by a steady rise in yield from lode sources beginning in 1853. The rich surficial placers easily worked by hand methods were rather well-skimmed off by 1865, but hydraulic mining gave maintenance to a fairly even total annual yield for the metal ($18,000,000 average) until the Sawyer injunction decision of 1884.

**1880** The years between 1864 and 1882 marked the yield of quicksilver from the bonanza orebodies of New Almaden, the record value being over $4,000,000 in 1875.

**1907** Petroleum production began noticeably to grow between 1890 and 1900, and surpassed gold in annual value in 1907, from which point it rose rapidly to the record value of $345,546,677 in 1926. In the period 1900-1925 gold dredging developed to importance, averaging about 50 percent of the annual yield of gold.

VIGNETTES OF THE FUTURE

# Colorado

**CHARLES W. HENDERSON**
*Supervising Engineer, Field Offices,*
*Bureau of Mines,*
*Denver, Colorado*

## IN RETROSPECT

**1850** Discovery of gold in the stream and bench gravel of Clear Creek near the junction with Ralston Creek, by Cherokee Indians.

**1858** Organized Green Russell party (including Cherokee Indians) from Auraria, Lumpkin County, Ga., discovers spotty gold deposits (reconcentrated from Tertiary Castle Rock conglomerate and perhaps Dawson arkose) on Cherry Creek and Dry Creek—tributaries of the South Platte River. Real reason for the "Pikes Peak rush." Bitter disappointment.

**1859** Placer gold discovered at Jackson diggings (Idaho Springs, Clear Creek County), Deadwood diggings (Pactolus, Boulder County), and Gold Run (Fourmile Creek, Boulder County); placer and lode deposits, Gregory diggings (Blackhawk, Gilpin County); placer gold, Russell Gulch, Tarryall Creek, South Fork of South Platte River at Fairplay, Breckenridge, Granite, California Gulch, and other locations.

**1868** Copper smelter at Blackhawk.

**1877** Discovery of lead carbonates at Oro. Beginning of Leadville rush.

**1885** Golden year of discovery in State.

WHO KNOWS what unforeseen conditions may make foolish any prophecy for the future of mining in Colorado? Since 1919 mining there has been living on its "fat." Gold at Cripple Creek, gold at Leadville, and silver at Creede were the last discoveries of moment, in 1891. Existence of molybdenite at Climax had been known since 1895, but the property was not opened until 1917. Despite loose talk about the deposit being a "whole mountain," the shape of the orebody was not determined until 1927-28 and it was several years later before the property was recognized as having the largest single orebody ever discovered in Colorado—namely, 400,000,000 tons. Abandoned old properties, first discovered in 1879 on Battle Mountain, near Redcliffe, began to be consolidated in 1912, but it was several years before the existence of a very large quantity of zinc sulphide and a core of pyrite-chalcopyrite ore containing commercial quantities of copper, silver, and gold was realized.

If history repeats itself, changes in metallurgy will doubtless be the key that will maintain production of metals in Colorado. Changes in our monetary system, as in 1934, can be a powerful influence. Use of geology will be necessary to reduce the cost of finding new orebodies.

To the large production of lode gold in the past—Colorado leads all other States in total output—a considerable amount will be added for many years. The State probably will maintain its lead over Montana in silver output. Placer gold output is certain to increase with the new installation of dredges at Fairplay and probable identification of channels on the Arkansas River between Granite and Leadville. I doubt if another lead camp as prolific as Leadville will ever be found. There is much hope for continued production of zinc, but only if much development is done. Sphalerite is a constituent of Colorado ores almost everywhere outside of Boulder County and Cripple Creek, but today only one mine has developed orebodies. Molybdenum production, now exceeding each year the annual output of gold, will doubtless continue for 50 to 100 years. If, as, and when the molybdenum deposit is exhausted, the value of its total gross output will exceed that of the gross value of Colorado gold production from 1859 to 1940. Nearly every ore mined in Colorado is a sulphide. Some day the sulphur content will be conserved by someone. In addition, there is known 10,000,000 tons or more of straight iron sulphide, with no impurities, from which steel could be made after the sulphur is removed. Copper production never will be big. Tungsten and vanadium deposits need much new development work.

Within the next 50 years, however, coal will become the most valuable resource of Colorado. If and when the petroleum resources of the United States become exhausted, gasoline can be made from Colorado coals, which at present are estimated to be sufficient to supply the current coal needs of the United States for 2,000 years. Moreover, when the price of crude oil goes to $3.50 a barrel, oil-shale can supply 60 billion barrels of oil.

**Plant and townsite of Climax Molybdenum, Colorado's unique mining enterprise, high up in the Rockies. Cave in upper left is above the mine workings**

# Idaho

**A. W. FAHRENWALD**
*Dean, School of Mines,*
*University of Idaho*
*Moscow, Idaho*

IMPORTANT IDAHO MINES today are the following: the Bunker Hill, Sunshine, Hecla, Morning, Star, Day Rock, Sherman, Page, Jack Waite, Polaris, Coeur d'Alene, Highland Surprise, and Constitution—all in the Coeur d'Alene district. From these are produced silver, lead, zinc, copper, arsenic, antimony, cadmium, and bismuth; the Bradley Mining Company, Valley County, produces antimony ore and gold, and is soon to produce tungsten; the Golden Anchor, Idaho County, and the Boise Rochester, Boise County, are Idaho's largest quartz gold producers; the Ima mine, Lemhi County, is a producer of tungsten, gold, silver, molybdenum, and copper; the Almaden mine, near Weiser, in Washington County, a producer of mercury; the Uncle Sam company, Lemhi County, produces gold, copper, nickel, and cobalt; and the mine of Anaconda Copper at Conda, phosphate rock. From the last, fertilizer is made and vanadium is now a byproduct.

There are ten dredges and many smaller widely scattered gold-producing operations adding their quotas.

That the future of mining in Idaho gives cause for optimism is evidenced by these facts: Ore reserves in the Coeur d'Alenes are large; the Bunker Hill has over seven years of blocked-out ore; the Star mine is in its youth and the Silver Belt only in its 'teens; production of cadmium as a valuable byproduct in making electrolytic zinc and only recently the production of electrolytic bismuth and antimony from the complex tetahedrite silver ores; discovery, development, and production of mercury (Almaden mine); development of large tungsten orebodies in the Patterson Creek area (Ima mine); extension and development of large antimony ore reserves at Stibnite (Bradley mine), and more recently in this same orebody the discovery of a large content of high-grade scheelite, perhaps the largest on the continent; discovery of scheelite in the Seven Devils district; recent discoveries of manganese of probable great importance in Washington County, and immense deposits of phosphate rock.

**Bunker Hill & Sullivan's mining enterprise is the greatest one in Idaho. Above, the lead smelter and refinery, at Kellogg, started in 1917**

## IN RETROSPECT

**1860** Gold discovered on Orofino Creek, Clearwater County, by Capt. E. D. Pierce. In quick succession came other finds: Elk City, Pierce City, Baboon Gulch, Florence, Warren, Idaho City, Placerville, Pioneerville, Orogrande.

**1862** Gold found in Boise Basin, yielding millions. It is still produced here.

**1863** Silver-bearing ore discovery in Owyhee County, later to rank as one of the West's richest finds. Quartz mining began a few years later. At 500-ft. depth the famous 500-lb. Poorman nugget was found.

**1866** Gold discovered at Leesburg, Lemhi County. The Leesburg mine produced over $16,000,000.

**1881** A. J. Prichard discovered gold near Murray, Shoshone County. This find, in itself not important, attracted attention to Coeur d'Alene district.

**1884** Tiger mine found on Canyon Creek, now Burke Canyon. This marked start of mining in Coeur d'Alenes. In rapid order came the Poorman, Frisco, Morning, Hercules, and Hecla.

**1885** Bunker Hill mine found in Milo Gulch, just above Wardner.

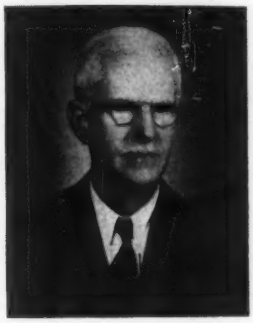
In addition to Idaho's high ranking position in production of silver lead, and zinc, the State bids fair to lead in the production of at least four strategic minerals: tungsten, mercury, antimony, and manganese. Asbestos, mica, and beryl are also produced.

Other high lights, not ore finds, are metallurgical discoveries and plant developments, and the sequence is something like this: Amalgamation in the 60's; cyanidation in the 90's; erection of the Bunker Hill smelter in 1917; introduction of bulk flotation in 1910 and 1911; differential flotation in 1922 and 1923; and Sullivan zinc plant in 1928; and now the introduction of the heavy-suspension sink-and-float process.

Each of these, and many not mentioned, new forward steps, the results of research, led to improved recoveries, operating efficiency and economies, and, in turn, made possible the economic mining of deeper, leaner, and more complex ores. The peak of the mineral industry of the State lies in the future.

# Missouri

**C. R. FORBES**
*Professor of Mining Engineering*
*Missouri School of Mines and Metallurgy*
*Rolla, Missouri*



## IN RETROSPECT

**1721** Phillippe Renault, son of a French iron founder, left France in 1719 with a party of 200 to develop a mining concession in Louisiana. From headquarters at Fort Chartres, Ill., prospecting parties set out in search of gold and silver. One of these, headed by Antoine de la Mothe Cadillac, discovered outcrops of lead ore near Mine La Motte, in Madison County, Mo., in 1721. From this find developed the Southeast Missouri lead district, worked continuously since.

**1864** Lead mining in Southeast Missouri up to this time had been confined to shallow workings. Total production was small and individual deposits were short-lived. Discovery of disseminated lead ore at 100 ft. depth in the Bonne Terre formation in 1864 by St. Joseph Lead Company was the beginning of a new era in lead mining in Missouri. The new discovery, in St. Francois County, was destined to make it the most important lead-producing district in the world.

**1869** St. Joseph Lead imported the diamond drill from France and used it successfully in prospecting the Bonne Terre formation. Intensive mining has since been carried on.

MISSOURI'S lead mines are about 60 miles south of St. Louis near Bonne Terre and Flat River. Production is controlled by the St. Joseph Lead Company, employing 2,500 men and operating five mills with a total capacity of 25,000 tons of ore per day. The company is also operating a mine and mill at Mine La Motte, near Fredericktown, 25 miles from Flat River. Because of these operations, Missouri has long ranked first among the States in lead production, which amounts to nearly one-third of the country's total.

The operators of Southeast Missouri have contributed much to the technologic advance of mining and milling in the United States. The diamond drill was first used there. Flotation was introduced in 1912. The district was one of the first to introduce underground loading machines, and hand shoveling was long ago discontinued. The Conway shovel, used in driving the California aqueduct and other tunnels, was developed there.

During World War I, the St. Joseph Lead Company was called upon to supply a tremendous amount of lead. In the present defense programs, Southeast Missouri is prepared to repeat this performance. Reserves have been maintained by continuous prospecting, surface and underground. Decline in grade has been offset by increased efficiency through complete mechanization.

The value of lead concentrates produced in 1939 is estimated at $14,000,000. Figures for 1940 will surpass this, and those of 1941 will be still higher. No repetition of inflated prices is expected.

The annual value of manufactured clay products in Missouri closely approximates the value of the lead production. The raw clay produced represents a million-dollar industry, situated largely in the east-central part of the State.

A super-refractory or high-alumina clay known as diaspore is found only in Missouri in four interior counties. Though the tonnage used by the refractories industries is small, it does constitute an important defense material. New deposits are being found from time to time, and no doubt this material will be available for many years.

Besides being first in lead, Missouri also ranks first in production of barite, the total value of the output being about $1,000,000 a year. It comes from two old-established districts in the southeast and central parts of the State. Until recently, hand mining accounted for most of the production, but on account of labor difficulties, power shovels and log washers are rapidly being introduced.

Missouri produces many other nonmetallic products, the most important of which are cement, limestone, sand and gravel, and lime. Their total annual value is approximately $15,000,000, about one-third of the State's mineral output.

In conclusion, Missouri's mineral industry is relatively more important than its output valued at $50,000,000 a year would indicate. Its production of lead, barite, and refractory clays contributes materially to the nation's defense program. Fortunately, the State can turn out these products in great quantities for many years.

**Power shovels load ore underground in the mines of St. Joseph Lead Company in Southeast Missouri**

# Montana

**FRANCIS A. THOMSON**
*President, Montana School of Mines, Butte, Montana*

THE FUTURE of the mineral industry of Montana is, in some measure at least, but an extrapolation of the curve of the past, and this is especially true of Butte. Butte is still a robust city perched on "the richest hill on earth" from which copper continues to flow in an unending stream from a seemingly inexhaustible source. Certainly, of course, that source must some day be exhausted, but there seems to be little concern among those intimately connected with the "hill" that its daily output of 750,000 lb. of copper will be halted during our lifetime.

The 4,200-ft. horizon is now under development and the program contemplates ten shafts to 5,000-ft. vertical depth. Meanwhile, Butte has become an important source of zinc with lesser lead, and is about to become the major source of domestic manganese supply.

Production of gold and silver from many small mines and prospects scattered throughout the western half of the State will continue to be an important part of the State's economy.

Philipsburg will continue to be the source of "battery" manganese in this country, although known reserves are not great. Tungsten recovery will continue, possibly on a large scale, from the Jardine mine, and new production may come from the Potosi district. Antimony ore deposits near Thompson Falls and Dillon may produce if the demand increases. Montana will apparently continue to lead in sapphire production.

Ranking non-metallic mineral in Montana is coal. Estimated minable reserves of bituminous and lignite are 400,000,000,000 tons, much of which may be converted into motor fuel.

Also to be counted for the future are 275,000,000 tons of phosphate rock for fertilizer; possibly 25,000,000 tons of vermiculite for heat, sound, and electrical insulation; and large deposits of commercial gypsum in Fergus County. A deposit of graphite in Beaverhead County appears to justify further investigation.

A potential new industry for Montana based on the long-known chromite deposits in the south-central area is about to come into being. Paul A. Schafer, in Montana Bureau of Mines and Geology Memoir 18, "Chromite Deposits of Montana," estimated that the deposits contain 10,000,000 tons of possible ore and 20,000,000 tons of speculative ore averaging 25 percent $Cr_2O_3$ that will concentrate to 40 percent $Cr_2O_3$ or slightly better. J. W. Peoples and A. L. Howland, in Geological Survey Bulletin 922-N, "Chromite Deposits of the Eastern Part of the Stillwater Complex, Stillwater County, Montana," write: "The fact that chromite has been found in the Stillwater complex at all altitudes from 5,500 to 10,000 ft. without any systematic change ascribable to difference in depth indicates that it probably would continue to any minable depth."

During the past year the United States Bureau of Mines has been diamond-drilling the Stillwater chromite deposits and plans are being pushed for production of chromite concentrate. It is hoped that Montana chrome will be much more than a mere war-baby.

**Anaconda's operations dominate the mining picture in Montana. Above, the headframe and idler stands of its Badger shaft at Butte**

## IN RETROSPECT

**1852** First discovery of gold in Montana at Gold Creek, near Pioneer.

**1862** Gold found at Bannack, first lode mining in State, and first mill built.

**1863** Placer gold discovered in Alder Gulch near site of Virginia City.

**1864** Placer gold discovered in Last Chance Gulch and in Butte district.

**1865** First lead smelter built by Hope Mining Company, of St. Louis, at Argenta.

**1867** Copper discovered in Parrot lode, in Butte district.

**1875** Silver discovered on Asteroid location at Butte and claim relocated as Travona. Silver mill built near by started by W. A. Clark in 1876.

**1876** Marcus Daly arrived in Butte. Acquired Alice silver mine.

**1879** Colorado & Montana built first successful copper smelter in Montana.

**1880** Marcus Daly bought Anaconda silver mine. Found copper ore at 300 ft.

**1895** First successful gold dredge in United States launched at Bannack.

# Nevada

**JAY A. CARPENTER**
*Director, Mackay School of Mines*
*University of Nevada*
*Reno, Nevada*

IN RETROSPECT

**1850** Discovery of placer gold in Nevada on the Overland Trail at Gold Canyon, now Dayton, which led in time to the discovery of the gold quartz veins of the Comstock Lode, at Gold Hill.

**1859** Discovery of Ophir croppings at Virginia City and identification of argentite followed by rapid location of great silver camps of Virginia City, Austin, Eureka, Hamilton, Candelaria, and Pioche, culminating in the Great Bonanza, with production of $100,000,000 in four years.

**1900** Discovery of silver at Tonopah, followed by that of gold at Goldfield in 1902, and then a series of rapid discoveries in other camps.

**1902** Optioning of Ruth copper mine near Ely, with subsequent development to justify building of railroad in 1906 to connect with transcontinental line, and erection in 1907 of mill and smelter.

**1917** Discovery and production of tungsten ores at Mill City and other camps.

**1934** Revaluation of gold, with development and mining of large low-grade bodies of ore by power shovel.

NEVADA'S future mineral production will depend on the precious and base metals. A half century of geological study gives no hope for an output of petroleum like that of California to the west, or of coal and iron ores similar to those of Utah to the east. However, it becomes possible with each decade to mine lower-grade ore deposits.

The surface area of the State with its scant overburden and vegetation has lent itself in the past decades to a pretty thorough search for the outcrops of metal deposits. The law of dimishing returns applies with each decade of new discoveries.

Outlook for continued high production of copper in the next decade is bright with the output of Nevada Consolidated and its neighbor, Consolidated Coppermines, and the Mountain City district, and the Copper Canyon and Copper Basin area south of Battle Mountain. There are more barren iron oxide outcrops to test the persistence of those interested in mine development.

Lead production will increase rapidly due to the working of lower-grade ores at Pioche, made possible by Boulder Dam electric power and erection of a large flotation plant.

Pioche will likewise be the banner district of the near future for zinc, as its gold-silver-lead-zinc milling ores carry their greatest value in that metal. An electrolytic refinery, now contemplated, for treating zinc concentrate at Boulder City would increase the profit and the output. The lead-zinc orebodies now mined in this district extend from fissures into limestone beds in the Cambrian formation, and offer the possibility of making Pioche one of the leading zinc-lead districts. The area covered by the Cambrian from Eureka to the Colorado River is being studied.

All manganese mines that operated in 1917-19 are active. The $500,000 Federal plant under erection at Boulder City, mainly to develop commercial electrolytic processes for recovering metallic manganese, adds to the interest. Probably the greatest future source of manganese in that locality besides the Las Vegas district is in the large reserves of low-grade precious and base-metal ores of Pioche.

The surprising number of promising discoveries of tungsten augurs well that Nevada will continue to lead in its production. Night prospecting with the fluorescent lamp has helped.

Each rise in the price of mercury is followed by discovery of new mines, with subsequent erection of reduction plants. Nevada will probably continue to be a variable factor in the United States production.

Present high demand for basic furnace lining in the steel industry has made the brucite deposit near Luning a steady shipper, and discovery of adjoining large-tonnage easily mined bodies of magnesite promises to make Nevada a source of this ore for production of magnesium metal in the San Francisco area.

The chief source of gypsum for plaster and cement in California has always been in Nevada. The State has been a steady shipper of clays and other non-metallics to the Pacific Coast and will yield a greater quantity as nearer sources become exhausted.

**The Ruth pit of the Nevada Consolidated Copper Company, one of the "porphyry" coppers, typifies the mining industry of the State**

VIGNETTES OF THE FUTURE

# New Mexico

**C. E. NEEDHAM**
*President, New Mexico School of Mines, Socorro, New Mexico*

TO DATE, the mines of New Mexico have produced about $1,000,000,000. This vast sum has come from the mining of copper, zinc, lead, gold, silver, potash, coal, clay, fluorspar, iron, lime, manganese, mica, molybdenum, tungsten, vanadium, tantalum, tin, pumice, stone, sand and gravel, salt, barite, gems, guano, gypsum, lithium, pigments, refractories, asphalt rock, sulphur, meerschaum, bismuth, and possibly others.

A State with such a variety of commercial minerals naturally can be optimistic about the future of its mining industry, for the minerals listed in the foregoing include raw materials that form the basis of many American industries. Furthermore, a number of mineral deposits are known which are believed to have commercial possibilities but which have not been carefully examined.

The increased activity in the production of base metals and non-metallics through the years is interesting. Many of the early camps, founded on rich near-surface deposits of gold and silver, are gone, and the profitable ore is largely exhausted. Taking their place, we have seen bodies of copper, zinc, lead, and potash blocked out. Without question, these "big four" will continue to loom large in New Mexico's mining industry.

I believe that in the field of non-metallics lies a bright future. New Mexico is handicapped by high freight rates and great distances from markets, and many of the deposits are hard to reach. Yet, population and industries are slowly but surely moving westward, and we in New Mexico are tired of paying freight eastward on raw materials and westward on the finished product. In time, industries, small at first, must move nearer New Mexico.

A survey of the State's mineral resources reveals that we have limestone, shale, iron ore, and gypsum for cements and lime products; gypsum for wall plaster, plaster board, plaster-of-paris, cold-water paint, filler for cloth and paper; clays and shales for brick, floor, roof, drain and sewer tile, pottery, and filtering purposes; kyanite, sillimanite, magnesite and fireclays for porcelains, firebricks, hearth linings, and other refractory products; pumice, diatomite, and garnet for scouring soaps and powders and abrasives; soda, salt, barite, alum, and sulphur for chemical industries; graphite, ocher, and sienna for mineral pigments; granite and other stone for building and ornamental work; impure limestone for rock wool; asbestos for brake linings, clutch facings, acid filters, shingles, heat insulation and fireproofing materials; fluorspar for steel making, ceramics, glass, cement, and chemicals; mica for electrical appliances; barite for drilling-mud, pigments, filler, and body producer; feldspar for ceramics; and sand for glass.

Obviously, the mining of these non-metallics will not forge to the front overnight. Some of these deposits have not been sufficiently examined and tested to know their real value; some may have no value; many will prove valuable beyond question.

With such an array of metals and non-metals, the future of mining in New Mexico is assured.

**Potash now adds distinction to New Mexico's list of mineral products. Above, headframe and plant of Union Potash Company, newest producer**

## IN RETROSPECT

**1801** Spanish mine copper at Santa Rita.

**1828** First authentic placer mining west of Mississippi at Old Placers, Santa Fe County.

**1866** Discovery of silver-lead ores in Magdalena district, Socorro County.

**1875** Discovery of gold-silver ore, Mogollon district.

**1891** Discovery of zinc ore, Hanover district, Grant County.

**1903** Discovery of high-grade zinc ores, Magdalena district.

**1909** Chino Copper Company organized.

**1925** American Metal Company acquired Pecos mine at Terrero, San Miguel County.

**1932** United States Geological Survey announces results of potash investigations in Eddy County.

**1939** Nevada Consolidated smelter blown in.

# Oregon

**EARL K. NIXON**
*Director, State Department of Geology and Mineral Industries*
*Portland, Oregon*

## IN RETROSPECT

**1851** Gold first mined in the State on a tributary of Jackson Creek a few miles west of Medford. Marked beginning of southern Oregon gold rush of that period.

**1861** Gold found in Griffin Gulch, southeast of Baker, led to the discovery of rich placer gravels on many streams of eastern Oregon. Discoveries of lode deposits followed.

**1889** First large-scale experimental plant ever built for concentrating sulphide ores by oil flotation was erected and operated near Baker City, using the Crilley and Everson process, growing out of the discovery made by Carrie R. Everson at Denver in 1885.

**1937** Completion of 6,000-ft. Coulter tunnel at Cornucopia Mines proved downward extension of productive veins mined in upper levels. Since then production of gold has consistently increased at Cornucopia until it is now among the few million-dollar lode producers of the country.

**1939** Bonanza Mines, Inc., located near Roseburg becomes—and continues to be—the largest quicksilver producer in the United States.

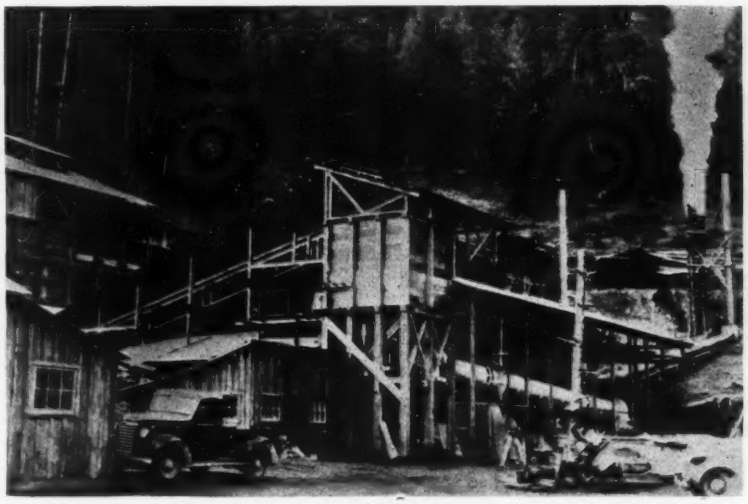
IN 1938, 1939, AND 1940 Oregon stepped out as an outstanding producer of quicksilver. Since the fall of 1939, the Bonanza mine, in southwestern Oregon, has been the largest individual quicksilver producer in the United States. Judging by the wide distribution of newly developed quicksilver properties, the State as a whole is expected to lead the nation within a few years in supplying the liquid metal. At present, two states, Oregon and California, produce about 70 percent of the domestic quicksilver output.

In the future, non-metallic minerals are expected to supply a larger proportion of the value of total mineral production of Oregon than metallics. A refractory clay industry is just getting started. For many years the State's cement industry has used large amounts of limestone; and a greatly increased quantity of agricultural as well as metallurgical limestone will be used in the future. Production of silica is increasing and should be stepped up substantially by demand from metallurgical plants in the lower Columbia basin. The refining and production of diatomite is increasing rapidly. Pumice and pumicite are beginning to move on account of the cutting off of importations from Italy. In the future, production and use of natural salts, and of garnet for abrasives, are also expected.

In the metallics, gold and quicksliver lead the parade at present and are expected to maintain their important production. However, with the expected installation in the Pacific Northwest of an electrolytic zinc plant, development of the complex sulphide orebodies of the Cascade Range is reasonably certain. Chromite from central and southwest Oregon has already begun to move under the impetus of the national emergency. One well-known old cobalt property is being reopened for investigation by a nationally known corporation. Interest is being shown in some antimony deposits in southern Oregon, and also in the Blue Mountains in the eastern part of the State.

Valuable research is being done on the utilization of the black sands of the Oregon coastal area. A combination of magnetic and electrostatic separation is employed experimentally, and an acceptable chemical grade of chromite is being produced together with, as a byproduct, a clean garnet fraction, which might have a wide use as an abrasive. Ilmenite concentrate, about 40 percent $TiO_2$, is also made.

Predictions as to the future of Oregon mining are somewhat complicated by the uncertainty of continued production of the strategic minerals, especially quicksilver and chromite. These two are receiving especial attention here during the present national emergency. However, various signs indicate that the future mining picture in this State will be on a broader basis, and it is even now on a much sounder basis, than it has ever been before. The rapid industrialization of the Pacific Northwest is creating a demand for a broader list of industrial products, which will directly benefit Oregon mineral industry. This in turn is beginning to bring back into balance the State's effective income.



**Oregon's Bonanza quicksilver mine in Sutherlin County, largest single producer in the United States, yields 500 flasks a month**

# South Dakota

**F. C. LINCOLN**
*Professor of Mining*
*South Dakota State School of Mines,*
*Rapid City, South Dakota*

GOLD has always been the principal mine product of South Dakota. In the 65 years from 1876 to 1940, the State produced 19,443,580 oz. of it and 9,172,957 oz. of silver, most of which was associated with the gold. The Homestake mine is credited with more than four-fifths of this output. From 1876 to 1940, it produced $466,786,898 in bullion and paid dividends of $133,229,242.

Gold should continue to be the principal mine product, but costs are rising so rapidly as to cast doubt on the ability of the mines to keep up their output. If these costs continue to rise, prospects and small mines will soon be forced to close, and eventually the larger operations will be affected. Already, increasing taxes have forced them to mine selectively, eliminating appreciable tonnages of rock of marginal value, which under less costly conditions would constitute ore. The only hope for continued large-scale production of gold in South Dakota seems to lie in downward adjustment of taxes, or in some form of subsidy.

A million dollars' worth of tungsten ore has been mined in South Dakota from replacement deposits in the Cambrian sedimentaries, and a small amount from Pre-Cambrian pegmatite dikes; but none has been produced since 1929. Due to increased demand, prospecting is in progress on several Black Hills properties, the most active work being done by Pioneer Tungsten Mines, Inc., on prospects in Two Bit Gulch.

An immense deposit of low-grade manganese-bearing material, estimated to contain more than 100,000,000 tons of metallic manganese, was discovered on the Missouri River near Chamberlain in 1927. The United States Bureau of Mines is now building a pilot plant near by to determine whether the manganese can be extracted economically. South Dakota may yet supply domestic needs of manganese.

South Dakota's quarries, producing sand and gravel, stone, and the materials for portland cement, rank next to her gold mines in importance. They may be counted upon to produce at slowly increasing rates.

Pegmatites abound in the Pre-Cambrian core of the Black Hills. They contain minerals which are being mined in growing quantities, the most important being feldspar, mica, and lithium minerals. The increase in feldspar shipments which has taken place in recent years bids fair to continue.

Sheet-mica prices may advance as a result of war conditions to a point where South Dakota may again become an important producer. The Etta mine of Maywood Chemicals has been the principal producer of lithium minerals in the past, but the Black Hills Tin Company has large deposits of low-grade spodumene which it has begun to mill, and there are a number of other companies which ship these minerals, so the production is likely to grow. No great increases may be expected in the shipments of the other pegmatite minerals.

Bentonite also is mined in South Dakota. This particular industry has grown rapidly in the past ten years and there is reason to believe that the progress will continue. The State ranks second in bentonite production.

**Yates shaft and South mill of South Dakota's Homestake Mining Company, leading gold producer of the United States**

## IN RETROSPECT

**1874** Placer gold discovered on French Creek, in Black Hills. A gold rush ensued.

**1876** Homestake lode at Lead discovered. Homestake company incorporated in 1877.

**1879** Mica mines were first opened. Shipments now mostly scrap.

**1883** Tin ore discovered in Etta mica mine, started boom. Little tin found.

**1885** State School of Mines at Rapid City authorized. Opened in 1887.

**1898** Tungsten ore was first shipped from the Black Hills.

**1916** Bentonite shipped for first time.

**1923** Feldspar first shipped, as result of reduced freight rates.

**1929** Bald Mountain Mining Company incorporated, succeeding Portland and Trojan.

**1934** Canyon Corporation incorporated. Has produced over $2,000,000 since.

# Tennessee

**WALTER F. POND**
*State Geologist*
*Nashville, Tenn.*

## IN RETROSPECT

**1797** Cumberland iron furnace and mines opened, still operating; 1814, coal mined near Rockwood.

**1831** State Geological Survey established; $1,000 in gold sold Philadelphia mint; 1837, first recorded manganese mining in United States; 1838, marble for National Capitol.

**1847** Ducktown mined 31,000 lb. 25 percent copper ore; 1854, copper smelter; 1855, Burra Burra mine opened (still operating); 1859, copper refinery, rolling and wire mill at Cleveland, Tenn.

**1875** First sulphide ore treated at Ducktown; 1904, copper "heap roasting" stopped by courts; 1907, Tennessee Copper Company, largest $H_2SO_4$ plant in world, first commercial use of low-grade $SO_2$ fumes.

**1908** Blue Grass Phosphate Company installed washer; 1911, American Zinc Company opened first large zinc mine.

**1937-38** Electric furnace production of phosphorus; 1939, Tennessee Copper Company bought Ducktown. Electro Manganese Corporation produced 99.99 percent manganese.

MINING IN TENNESSEE is so varied that economic depression or failure in production of one or two minerals cannot drag down the entire industry. Although coal production accounts for about 25 percent of the entire dollar value of production, cement, clay products, marble, phosphate rock, copper, sulphuric acid, zinc, stone, lime, and sand and gravel each produce a value of over $1,000,000 per year. A half dozen other minerals are also important. None of the deposits of the minerals mentioned shows any signs of approaching exhaustion.

The readers of this journal, being principally interested in metal mining, may not think, perhaps, that the copper, zinc, and small iron and manganese operations justify consideration of Tennessee as a mining State. However, when one realizes that many metallic mineral deposits are of limited extent and that the non-metallics or industrial minerals such as coal, cement materials, marble, stone, and sand and gravel are in deposits of practically unlimited extent, he is impressed not only with the probability of long life, but also with the probable increasing use of such materials in the development of our industrial life.

Though the iron industry, after a long, prosperous era, was practically knocked out by development of the Lake Superior ores, there are many millions of tons in reserve in Tennessee which will be mined in the future. Even now, with the early completion of 9-ft. navigation on Mississippi River tributaries reaching into the iron, coking coal, and limestone flux areas and giving low-cost transportation to widespread markets, these iron ores may be on the threshold of renewed developments that will mean much to Tennessee. Changes in economic conditions will bring these deposits into their own in due time.

Mining of phosphate rock has increased recently to new records of practically a million tons per year. The necessarily increased use of fertilizers to maintain soil fertility will increase the demand. Recent improvements in washing and use of low-grade rock have vastly increased reserves, so that several hundred years' supply are estimated to be in sight at the present time.

Geological researches and recent prospecting lead to the belief that there are many areas where new zinc deposits will be found. For at least the present emergency, the manganese deposits of East Tennessee will receive increasing attention and development.

Ceramic materials in Tennessee and the raw materials, such as high-grade limestones and dolomites, coal, sulphuric acid, nearby salt, and low-cost power, for a chemical industry are, perhaps, our most valuable undeveloped mineral assets. A network of low-cost river transportation will lead to widespread markets. Mining of the raw materials for these industries will employ many miners and engineers and demand much in the way of mining machinery and supplies.

Taken altogether, the prospects for an increasingly active mining industry seem bright.

**Smelter and acid plant of Tennessee Copper Company at Copperhill, in the Ducktown Basin of Tennessee, a region that yielded copper in the Sixties**

# Utah

**O. N. FRIENDLY**
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*Park Utah Consolidated Mines Company*
*Salt Lake City, Utah*

A SURVEY of what may be expected in the future must first offer a picture of the immediate past and the present. Utah, in the ten-year period of 1921-30, had an average production of 171,000 oz. of gold, 17,295,000 oz. of silver, 213,000,000 lb. of copper, 239,000,000 lb. of lead, and 57,000,000 lb. of zinc, valued at $66,000,000. Average production for 1939 and 1940 was: 315,000 oz. of gold, 11,000,000 oz. of silver, 402,000,000 lb. of copper, 145,000,000 lb. of lead, and 78,000,000 lb. of zinc, valued at $75,000,000.

Inspection shows an increase in output of copper and zinc, but a disturbing decrease in that of silver and lead. Expanded operation of Utah Copper's open-cut mine was responsible for the increased copper output, no new copper properties having come into the field. Future output of copper will be largely controlled by the operations of this one company. Estimates of its ore reserves are dependent on the copper content of rock which can be mined at a profit in the future. Sufficient minable rock is available to maintain production for some years.

Utah's mineral output is nearly all from Bingham, Park City, and Tintic. These districts still have large, undeveloped, potential mineral areas, capable of keeping the State in its position as one of the chief sources of metal for the nation. Future prospecting, however, must be carried on at depth and will require prolonged development campaigns. Other districts now with small production await further capital expenditure.

Decrease in a ten-year period of 33.4 percent in the State's output of silver and a 39.4 percent decrease in lead output signifies that the search for new ores has not kept pace with mining. Increase in zinc production of 38 percent is a tribute to progress in metallurgy, though due partly also to extension of operations to a lower zone of mineralization.

Despite recent improvement in the metal markets, under most favorable interest rates for capital, we have a most disturbing situation, in a State where mining provides the direct support of a large proportion of the inhabitants. Rapid decrease is evident in the desire to invest in search for new mines.

A forecast of the future of Utah production must recognize the fact that future prospecting and development must be left almost entirely to the few large mining corporations with multiple properties. The present form of tax laws prevents profits of over 8 percent of the investment without excess tax penalties. Multiple operations, combining successes and failures, are necessary to relieve this burden and retain an incentive for hazardous mine development. The few large corporations upon which future expansion depends are already efficiently engaged. It is not probable that they can, or will, in the next decade, assume all the responsibilities of the required mine exploration and development. Two other factors in the decrease in the development of new properties are the present difficulty of perfecting mine patents and the new restrictive regulations which prevent the past freedom of developing mines by the useful method of leasing.

**Utah Copper's open-pit mine at Bingham is running at capacity, producing 80,000 tons of low-grade copper ore per day. Shovels and trains provide a scale**

## IN RETROSPECT

**1870-1900** This was the era of the prospector and the individualist operator in Utah. During this period the rise of all present producing mining districts took place and recognition was made by the State that mining was a major resource.

**1900-15** This decade and a half was a period of further prospecting and development. In the course of it a realization was acquired as to the magnitude of the porphyry copper. Advance was made in metallurgy and the economic importance of zinc was given appropriate recognition. Consolidations of mining properties continued and production of metals increased.

**1915-40** During this period the impulse of the war years was felt by the mining industry. In it the costs of labor increased and greater mechanization of operations took place. Consolidations of properties became larger. Then followed the pause through the years of depression. The industry became subject to political and governmental regulations. New types of mine taxation were devised. This was followed by the stagnation of the prospecting work that had been done by the small company and the individual operator.

# Washington

**A. E. DRUCKER**
*Dean and Director*
*School of Mines and Geology*
*State College of Washington*
*Pullman, Washington*

## IN RETROSPECT

**1833** First official cognizance taken of mineral resources in what is now Washington when Dr. W. F. Tolmie, of Hudson's Bay Company, reported discoveries of coal.

**1855** Placer mining for gold started near Fort Colville, in Stevens County, and continued for several years.

**1887** Copper discovered on what is now the Holden property. Staked some years later by J. H. Holden. Driving of first prospect tunnel in 1893 was followed by years of inactivity until 1928, when Howe Sound Company took option. After extensive exploration that company built a 2,000-ton concentrator in 1937, since when the enterprise has been profitable and the largest metal producer in the State.

**1940** Up to end of year the total output of Washington's minerals from the earliest settlement is estimated at $750,000,000. For many years production averaged nearly $20,000,000 annually, coal predominating until ten years ago. In 1936, the output exceeded $23,000,000; in 1937, $26,000,000; in 1939, $34,000,000; and in 1940 it was approximately $35,000,000.

TODAY a number of new electrochemical and electrometallurgical industries can be mentioned as possibilities for the State of Washington. These would utilize large amounts of low-priced electric power generated at Bonneville and Grand Coulee dams and raw materials drawn from the resources of this region. Among the metals that might be produced are electrothermic magnesium and electrolytic aluminum, manganese, zinc, and chromium. Other possibilities would include sodium chromate and dichromate, electric-furnace iron and steel from scrap iron, silicomanganese, the ferro-alloys, alumina, and by-products from high-alumina clays. Industries producing aluminum and ferro-alloys have already been established on the lower Columbia River. Likewise, industries for fabricating light metal alloys of aluminum and magnesium will also be established in Washington.

Among the possible industries that would draw upon the region's nonmetallic resources are those that would produce phosphate fertilizers for the farms, calcium carbide, fused silica glass building blocks, silicon carbide, abrasives, and refractories. Calcium-carbide furnaces are now operating on the lower Columbia. The State also has resources of high-grade kaolin, silica sand, and muscovite mica.

The key to the future development of industries yielding these electric-furnace products in this region will largely be found in the availability of low-cost power from Grand Coulee and Bonneville and ample reserves of ores and raw materials within an economic power-transmission distance.

Increasing importance of the lighter metals in the national preparedness program, and their great value in airplane construction, offer real opportunities for the growth of an industry in this State that will prove permanent after the emergency has passed.

Large deposits of suitable clays of high-alumina and low-iron content are to be found in eastern Washington and in northern Idaho. With the availability of low-priced power and the development of economic methods of extraction for aluminum and other available byproducts, Washington has good opportunites. The alunite deposits in the western part of the State will also afford a source of alumina.

Washington also has large deposits of magnesite ore a short distance east of the Grand Coulee power development. These will constitute ample reserves for many years. Available for use is a recently developed milling and selective flotation (Doerner-Harris) process for the lower-grade deposits.

The very low cost of power (1.65 to 2 mills per kilowatt-hour) on the Columbia River has greatly stimulated research in this region for electric-furnace and metallurgical possibilities and new industries. Washington should become an important electrometallurgical and chemical manufacturing region during the next few years, and mining operations will be greatly extended to furnish the necessary raw materials.

**Extensive deposits of magnesite make Washington the leading producer. Northwest Magnesite Company's new mill concentrates waste rock by flotation**

VIGNETTES OF THE FUTURE

# Tri-State District

**EVAN JUST**

*Secretary, Tri-State Zinc and Lead Ore Producers Association*
*Picher, Oklahoma*

IN RECENT YEARS the Tri-State district has furnished 40 percent of the nation's mine output of zinc and 10 percent of the lead. However, it accounts for more than half the economically marginal zinc production of the country. It would be hard to name an industry with a future more uncertain.

Prior to the second World War, the future looked black indeed. It seemed as though expanding production in foreign countries, aided by the Government's tariff-reducing program, would soon suppress most of the Tri-State activity. When war broke the immediate outlook was reversed. With much of the world's zinc smelting facilities in Axis hands and subject to the British blockade, the burden of supplying domestic needs, plus those of neutral countries and part of British requirements, fell on the domestic industry. Prices rose, but even though the domestic output was nearly doubled, all needs could not be met. This was not improved by imposition of an arbitrary price ceiling on zinc. To satisfy requirements of the defense program the industry was recently forced into a priorities system by the Government.

For the rest of the war there will be a strong demand for concentrates. But what lies beyond? Will foreign competition stifle our output? Will our Government turn to a policy of self-sufficiency? Will Canada and Mexico amalgamate with us? Will forced or subsidized production be employed as an international political instrument? Will we be able to maintain living standards—and production costs—much higher than those of the world at large? Nobody can say. The future of Tri-State mining must remain a riddle even to men who are best acquainted with the district.

If either a lowering of living standards or a national policy continues to make this country self-sufficient in zinc, it can be expected that the Tri-State will be called upon to furnish at least a third of the national production. No other known zinc-producing area could assume its load. On the other hand, if foreign competition should be given the same access to our market that existed before the war, enough zinc can be furnished from abroad, at prices the district cannot meet, to ruin the Tri-State industry.

Known reserves minable at present prices add up to three years' supply, at present rate of output, of a grade of ore averaging 5 percent combined zinc and lead concentrate recoveries. This means that there is no definite basis for predicting more than three years' supply at the present production rate.

If adverse circumstances should cause a sufficient shutdown of the Picher field—which currently accounts for 90 percent of the district production—to permit the workings to fill with water, it seems doubtful that any remaining reserves could pay for the expense of dewatering. In addition to the ordinary task involved in dewatering such an area is the additional water represented by the great volume of the workings themselves. Also, the water pollution problem in dewatering such an area after it has been exposed to oxidation and submerged would be very difficult.

**Typical terrain of the Tri-State District, showing mills and tailings piles in the vicinity of Picher, Oklahoma**

## IN RETROSPECT

**1848** Lead was discovered near Joplin, Mo., at this time. For twenty years thereafter the shallow "diggings" were mined for the lead ore only, the zinc minerals being discarded.

**1870** Zinc by this time had became a commercial metal and the Joplin district boomed into an important zinc-producing area. Larger and somewhat deeper mines were developed.

**1906** Discovery of zinc-lead ore by drilling for water on the Oklahoma prairie adjacent to the Joplin district opened the Commerce-Picher area. The Picher field developed rapidly into the greatest zinc field in the world.

**1921** The Tri-State District, so-called because the zinc-producing area now covered the three adjoining States of Missouri, Kansas, and Oklahoma, produced two-thirds of the nation's mine output of zinc, which was half of the world production. The peak for the district, that had been established in 1926, was 956,320 tons of concentrates, combined zinc and lead, value $52,508,959.

IN RETROSPECT

**When the first shipment of iron ore was made in 1854 from the Marquette Range, in Michigan, reports sent back East were that an inexhaustible supply of rich ore had been discovered. At that time the annual production of iron and steel in the United States was 750,000 tons—less than we now produce in three days. In 1877, shipments started from the Menominee Range, and in 1884, from both the Gogebic and the Vermilion. By 1890, iron and steel production had increased to 13,000,000 tons per year, and the Lake Superior district was shipping about 9,000,000 tons of ore annually. Then, in 1892, shipments started from the great Mesabi, and again reports sent East were that the supply of ore was inexhaustible. This time the reports seemed to be true, and when in 1911 the Cuyuna Range entered the shipping list, it was believed that the Lake Superior district could furnish iron ore indefinitely. Since the first shipment in 1854, the district has produced a grand total of 1,800,000,000 tons of merchantable ore or ore that was made so by simple concentration methods. Instead of being inexhaustible, this great ore supply will be exhausted in 20 years at the present rate.**

VIGNETTES OF THE FUTURE

# The Iron Country

**E. W. DAVIS**
*Director, Institute of Technology*
*Mines Experiment Station*
*Minneapolis, Minn.*

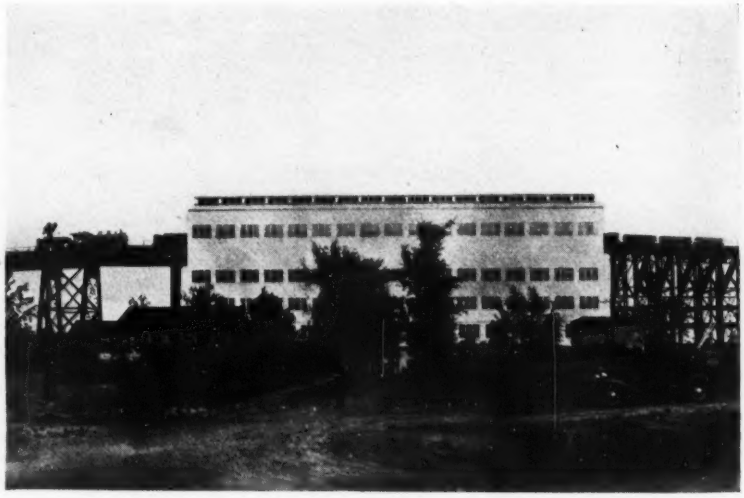
IRON MINING in the Lake Superior district is passing through the same cycle as gold mining at Cripple Creek and copper mining at Butte. First, mining efforts were directed toward high-grade ore, and when this was practically exhausted attention was given to low-grade ores. The high-grade iron ores are being rapidly exhausted, and attention is being given to the huge quantities of low-grade. Several steel companies are concerned about reserves, and, realizing that supplies must come from low-grade ores, have started accumulating them and developing methods to make them available when needed. Tonnage figures in the industry are enormous, and so the production of any large part of requirements from low-grade ores will involve great expansions in tonnage extracted from the earth and in plants for ore concentration.

Consider the Mesabi: In the past, normal production has been about 35,000,000 tons per year, of which 25,000,000 has been open-pit ore, 3,000,000 underground ore, and 7,000,000 concentrates produced chiefly from simple wash ores. The war has speeded up operations, but most of the extra tonnage needed will come from the Mesabi open pits. At the 1941 rate, estimated at over 55,000,000 tons from the Mesabi, all of the pit ore and most of the easily concentrated low-grade ore will be exhausted before 15 years. Then, the underground mines and the more complex low-grade ores must meet the inevitable demand for iron and steel by American industry.

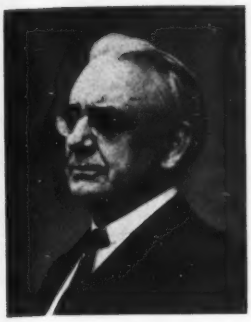
The Mesabi iron formation is known as taconite. This is a hard, dense, fine-grained rock from which high-grade ore can be extracted only after crushing to —100 mesh. The concentrate made either by magnetic methods, flotation, or gravity processes must be agglomerated for the furnaces. To produce 30,000,000 tons of taconite concentrate per year will require investment of possibly $100,000,000 in equipment, and for operation will require 15,000 men. Other low-grade ores on the other ranges have similar concentrating characteristics, so, obviously, great development in iron mining is to be expected throughout the iron districts.

Present concentrators in the district—some 25 in number—can produce over 10,000,000 tons of concentrates annually, but most of these are washing plants, and little good wash ore remains. Jigging and high-density plants are being built, but the amount of ore that can thus be concentrated satisfactorily is limited. Production from underground mines can be expanded and will soon be, on the Mesabi at least, but the cost of producing underground ore is about the same as that of producing taconite concentrate, and about the same number of men are required per unit.

The long-range view indicates great increase in underground mining, decrease in washing, increase in jigging and high-density concentration, and great development in concentration of taconite and like materials. It all adds up to indicate great industrial expansion and increased prosperity for the iron districts, and a higher ore cost for the steel companies dependent on the northern ranges.



**Oliver Iron Mining Company's Trout Lake concentrator on the Mesabi—the Iron Country's first large-scale washing plant. Photo courtesy U. S. Steel Corp.**



# Alaska

**PHILIP S. SMITH**
*Chief Alaskan Geologist*
*Geological Survey,*
*Washington, D. C.*

PURCHASED BY THE UNITED STATES in 1867, Alaska was still part of the Russian Empire 75 years ago, and its mineral resources were undeveloped. The earliest mining that yielded significant amounts of minerals began in 1880, since when products of many kinds to the value of more than $830,000,000 have come from Alaska mines. Gold accounts for about two-thirds and copper for one-quarter. Silver, coal, marble, platinum metals, lead, and tin have each contributed amounts ranging from $1,000,000 to $14,000,000, and petroleum, limestone, gypsum, antimony, tungsten, quicksilver and chromium have furnished smaller, but significant, additions. Nickel, arsenic, bismuth, molybdenum, sulphur, and graphite, though known, have not yet been exported in sufficient quantities to have affected appreciably the total stated.

Throughout most of the Territory, remoteness, lack of extensive transportation facilities, and the high cost of operating, have hampered development of most mineral commodities that have a low selling price in relation to their bulk. Gold, however, has always had a high selling price in relation to volume, and generally could be recovered in readily salable form without elaborate or complicated equipment or processes. Hence, its preeminent rôle in the Territory's economics.

The meteoric growth of Alaska's copper industry took place in spite of remoteness of the deposits and the low price of copper, because the deposits were unique, abnormally high-grade lodes of sufficient size. Unfortunately these have been worked out and there is little reason to expect that others comparable will be found.

The significance of this history lies in the light it can throw on the future. Are the halcyon days of mining in the Territory past? Certainly there are signs pointing to an upward trend and a continuing healthy growth. For instance, in 1940 the gold output marked the all-time high in value and the production of coal exceeded the output for any preceding year. Platinum metals mined in the past three years have had an average total value of about $1,000,000 and have placed the Territory among the principal world producers.

That there are many other sites of mineralization than those now mined is demonstrable. That some of these areas may contain commercial deposits seems likely. It is doubtful that any of these latent deposits will be bonanzas. Inevitably, as Alaska as a whole develops, a wider range of mineral materials than those now attractive will be sought.

The most notable new contribution that Alaska has made to mining practice is in the development of methods for treating frozen deposits.

To sum up: The past history of Alaskan mining is marked by notable achievements; the present shows a healthy state of growth. The future should show not only increased output of the minerals now mined, but also the inclusion of additional ones. Indeed, there is every reason to believe that the name of Alaska will continue to be synonymous with that of the fabled Eldorado, as a land endowed with great mineral wealth.

**Stripping, thawing, and dredging of alluvial deposits, shown near Fairbanks, yields about 70 percent of Alaska's gold production**

## IN RETROSPECT

**1866** Alaska was still part of the Russian Empire. Gold, coal, and native copper had been discovered but had not been developed.

**1880** First significant production of the precious metals from Alaska deposits (placer gold from near Juneau $6,000) was recorded.

**1895** In this year the annual value of Alaska's lode gold production first exceeded $1,000,000, mainly from mines near Juneau.

**1898** Stampede to the Klondike and an overflow into Alaska marked the beginning of the great placer gold output from the Territory.

**1911** Beginning of enormous expansion of production from the copper mines in the Copper River region.

**1916** The all-time high in the value of the annual mineral production of all kinds from mines in Alaska ($48,386,000) was recorded in this year.

**1940** In this year was the all-time high in the value of the annual gold production from mines in the Territory (approximately $25,400,000).

VIGNETTES OF
THE FUTURE

# CANADA

## ONTARIO

**M. E. Hurst**
*Provincial Geologist, Toronto*

THE GEOLOGY and mineral possibilities of the more readily accessible parts of the Province are fairly well known, but in a number of areas, particularly in northwestern Ontario, little mapping and prospecting have been done.

The gold deposits of Ontario are associated chiefly with greenstone-sediment belts of Pre-Cambrian age. Favorable ground for the occurrence of additional deposits remains in the vicinity of the established mining camps and in other greenstone-sediment belts not fully prospected.

A large deposit of high-grade hematite is awaiting development at Steeprock Lake, west of Port Arthur, and low-grade iron deposits requiring beneficiation occur in many parts of northern Ontario.

Large deposits of iron pyrites, some of which were worked during the last war and are now dormant, occur in the northwestern part of the Province.

Further exploration will undoubtedly add to the already vast reserves of nickel-copper ore in the Sudbury district. The territory north of Georgian Bay, between Sudbury and Sault Ste. Marie, contains extensive deposits of quartzite suitable for metallurgical purposes. This area is also believed favorable for copper-lead-zinc occurrences.

To the south of James Bay are deposits of lignite, china clay, and gypsum awaiting development.

In southern Ontario there are extensive deposits of brucitic limestone and dolomite. Further search will no doubt reveal additional occurrences of mica, soapstone, fluorite, apatite, molybdenite, feldspar, nepheline syenite, beryl, and the rare-earth minerals.

## SASKATCHEWAN

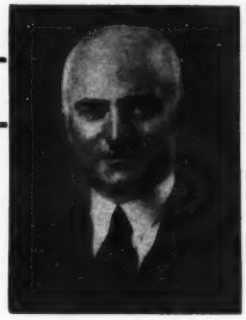
**W. H. Hastings**
*Chief Inspector of Mines, Regina*

ALTHOUGH it has been known for half a century that the northern third of Saskatchewan is underlain by potential mineral-bearing formations, it has only been within the last decade that the people of the Province have become in any degree mining conscious. In 1931 there was no production of metallic minerals in Saskatchewan. In 1939 the value of metallic mineral production amounted to six and a quarter million dollars. The results of this short period of development have been such as to warrant a well-founded optimism for the future and the conviction that the 90,000 square miles of practically unexploited Saskatchewan Pre-Cambrian forming the northern third of the Province will yield its full quota of producing mines.

Until the advent of the airplane and its widespread use in transportation, mineral reconnaissance and aërial photography, northern Saskatchewan remained a little-known and unexplored hinterland inhabited only by trappers, fur traders, and Indians, thus preserving large areas of virgin prospecting territory for the prospectors of tomorrow.

Though agriculture will always remain the basic industry of Saskatchewan, the Province looks forward with confidence to the time when an ever-expanding mining industry will become an important factor in the industrial life of the country and will help to give the Province a much needed and better-balanced economy. Gold, silver, copper, and zinc are the principal metals produced, with cadmium and selenium as byproducts. The Province produces about a million tons of lignite per annum. There are indications, also, of nickel, cobalt, molybdenum, lead, and radium.

## QUEBEC



**A. O. Dufresne**
*Deputy Minister of Mines, Quebec*

UNTIL 1927 the Province of Quebec was essentially producing non-metallic minerals and quarry materials, but the discovery in the early 'twenties of rich copper and gold deposits in the western part of the Province, at the latitude of the Kirkland Lake and Porcupine camps of Ontario, completely changed the picture of its mineral industry. Large bodies of sulphides containing copper, zinc, gold, silver, selenium, and tellurium are now mined at Noranda, Aldermac, Amulet, Waite, and Normetal, as well as gold in the quartz veins and the siliceous bodies in

Asbestos mining, in the Eastern Townships, began in 1878; and has grown to be a very important industry. Some 6,650,000 tons of fiber-bearing rock is mined yearly, yielding about 368,000 tons of asbestos, valued at $16,000,000. Chromite occurs in the Appalachian ranges.

Attempts were made in the 'eighties to establish a phosphate-mining industry in the Buckingham region, many deposits of which are still being worked for their amber mica content. From time to time small quantities of titaniferous iron ore have been mined in the southern fringe of the Pre-Cambrian plateau. This section also has yielded appreciably large tonnages of lead and zinc ores, high-grade feldspar, dolomite, kaolin, and industrial quartz.

Geological reconnaissance work has mapped several areas favorable to prospecting between the Transcontinental Railway and James Bay, and attempts have been made at development of gold and copper deposits in such places as Rose Lake, Opemisca Lake, and Chibougamau. Further in the hinterland, the existence of important high-grade hematite deposits has been reported. The Pre-Cambrian forma-

tion between Hudson Bay and the Labrador and St. Lawrence coasts is a vast expanse of mineral possibilities, to which must be coupled the much smaller but very interesting interior of the Gaspé Peninsula, with its copper, zinc, and lead occurrences.

## MANITOBA

**George E. Cole**
*Director of Mines, Winnipeg*

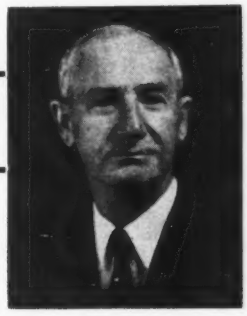
FROM AN AREA of some 252,000 square miles, three-fifths of which is underlain by rock of Pre-Cambrian age, may be anticipated a continued production of gold, silver, copper, and zinc, in addition to such elements as cadmium, selenium, and tellurium.

The geological history of the Province, together with collected evidence of production and experience in development, permit the following general predictions concerning the future of the mineral industry: The most promising future lies in metals to be produced from the high-temperature, deep-seated type of vein and replacement deposit. The metals expected from these deposits are mainly gold, silver, copper, and zinc. Smaller quantities of lead and cadmium may be produced as byproducts in the development of ores of the former metals. There are potentialities in nickel and notably in the rare metals, such as lithium and beryllium. Tin, molybdenum, and tungsten are possibilities, and prospects of these metals are known.

It may be stated that apart from one or two localized areas the greater part of the known mineral areas has been incompletely prospected, leaving large areas practically unexplored. Geological maps are obtainable upon request for most of the mineral areas.

Timber and cheap hydro-electric energy are available for mining operations and nowhere is transportation a difficult problem.

## NORTHWEST TERRITORIES



**George Hanson**
*Assistant Chief Geologist Department of Mines and Resources, Ottawa*

FROM THE VIEWPOINT of annual value of production, gold is at present the mineral of chief importance in the Northwest Territories, the value of its output in 1940 being $2,121,350 out of a total of $2,597,754. The entire output comes from four properties in the Yellowknife River area on the north side of Great Slave Lake, where production began in 1938. A few other gold properties in this and in adjoining areas are nearing the production stage and prospecting has been active in the region. The Canadian Geological Survey has now mapped, in a systematic way, some 35,000 square miles of territory in the vicinity of Great Slave Lake, and about one-third of this area is considered favorable for the occurrence of metallic mineral deposits.

Ores of radium and silver were discovered in 1930 at Great Bear Lake, and by 1939 Canada was supplying 40 percent of the world requirements of this rare mineral. Owing to disruption of world markets by the war, operations at the mine were discontinued in June, 1940, but sufficient concentrates are on hand to enable the radium refinery at Port Hope, to operate for several years.

The occurrence of deposits of native copper on Coppermine River, Bathurst Inlet, Boothnia Peninsula, and on several of the Arctic islands, has been known for many years. Some of these deposits appear to be of great size and would have been developed were they not so distant from settled parts of the country. Deposits of copper-nickel minerals are known to occur on Rankin Inlet, on the west side of Hudson Bay, but they are not being developed. Lead-zinc deposits occur in limestone south of Great Slave Lake.

Oil-bearing rocks in the Mackenzie Basin were known to the early explorers, but no considerable quantity of oil was found until 1920, when Imperial Oil, Ltd., brought in a well at Norman, about 50 miles west of Great Bear Lake. Since 1934, however, it has supplied much of the oil requirements of the mining properties in the Northwest Territories. Gypsum and salt occur in an area extending from Great Slave Lake to the south boundary of the Territories.

## NOVA SCOTIA

**Alan E. Cameron**
*Deputy Minister of Mines, Halifax*

NOVA SCOTIA is the mother of gold mining in Canada, and yet the industry languishes. The geological structures do not lend themselves to large-scale production, but there is not a single gold district in the Province that does not warrant further development of small mining operations.

Tungsten deposits have attracted attention since the outbreak of the war, and some properties that produced appreciable tonnages during the first World War have been reopened and sampled. The potential value of the scheelite associated with gold-bearing structures was realized two years before the outbreak of the present war. Investigations are continuing and one or more properties may be producing tungsten before the end of the year.

Nova Scotia has long been known as a possible producer of manganese. Considerable tonnages of high-grade pyrolusite have been produced at different points in the Province, notably in Lunenburg County and along the south shore of Minas Basin. In other places lower-grade manganite and bog manganese deposits are known. Present evidence indicates that small scattered deposits exist over considerable areas too widely separated for mining from a central point, but close enough to warrant blending production to yield a marketable product.

The list of industrial minerals of Nova Scotia is a large one, including barytes, diatomite, dolomite, fireclay, fluorspar, gypsum, peat, and salt. Subject as these minerals are to intense competition in normal times, the Nova Scotia deposits have not had the opportunity that they deserve. Today, under war conditions, with normal market supplies disrupted, they offer an opportunity for sound development. They are accessible, close to power, and close to good transportation. With tidewater almost at their doors, they are particularly well sited for markets on the eastern seaboard of North and South America.

## NEW BRUNSWICK

**W. J. Wright**

*Provincial Geologist, Fredericton*

RESERVES OF BITUMINOUS COAL in New Brunswick are sufficient to permit the present rate of production for many years. The known reserves of gypsum are immense and several extensive deposits are unexplored. The proved oil and gas field is small, but an immense area merits exploration by modern methods. In addition, large quantities of oil and ammonium sulphate are locked up in deposits of high-grade oil shale. Supplies of high-calcium limestone and dolomite are available far in excess of the present needs, and we are told that the raw products for cement are conveniently located in the Province. The reserves of rock salt are unlimited; a bed of this material several hundred feet thick, and an associated bed of glauberite, have been partly explored by drilling; springs of sodium chloride and bitter waters occur over many square miles. Diatomite of excellent quality occurs in numerous deposits.

Manganese is the only metallic mineral which has been mined in recent years. The known manganiferous area is extensive and largely unexplored. Three "hard ore" properties are being developed at present. The large deposits of bog manganese are idle. Important metallic prospects are tungsten, molybdenum, tin, silver-bearing lead, and zinc. In addition there are large bodies of low-grade iron ore and an immense deposit of low-grade manganiferous iron.

## ALBERTA

**J. A. Allan**

*Professor of Geology, University of Alberta, Edmonton*

ALBERTA is essentially a fuel-producing province. Its mineral industry has been restricted by economic factors, of which transportation facilities and distance from markets are of major importance.

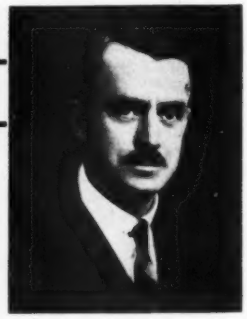
The coal resources are large. The rank ranges from high-grade bituminous to lignite, and the coal problem is one of transportation costs to Eastern markets.

Petroleum production in Alberta has expanded six times in ten years. Ninety-nine percent of an annual production of nine million barrels is from Turner Valley field, comprising 30 square miles. The future of the petroleum industry will depend on the discovery of new fields, but about one-third of Alberta still unproved has petroleum potentialities.

Bituminous sand deposits in northern Alberta underlie at least 10,000 square miles with an oil content of about 13,000 bbl. per acre.

Other than fuels, Alberta has a salt industry at Waterways, 300 miles north of Edmonton. At least 30,000,000 tons have been proved by drilling. Increased production of common salt will depend on reduced freight rates, a wider use for salt, and increased population. There are extensive undeveloped deposits of high-grade gypsum not yet commercial because of the geographic factor.

## BRITISH COLUMBIA



**John F. Walker**

*Deputy Minister of Mines, Victoria*

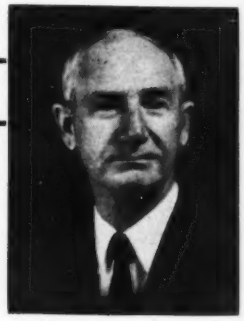
THE GREATER PART of British Columbia lies within the Western Cordillera. Of its area about 2 percent constitutes good arable land, 40 percent is capable of producing merchantable timber, 75 percent is not unfavorable to the discovery of mineral deposits, and 10 to 15 percent is not unfavorable to the discovery of natural gas and petroleum.

Seventeen percent of the area of the Province has been geologically mapped on four miles to the inch; small parts of the area have been mapped on larger scales. The Federal Department of Mines is carrying out a systematic scheme of four mile to the inch mapping. The Provincial Department of Mines supplements this work.

Not more than 25 percent of the area of the Province has been prospected. There are areas favorable to organized prospecting. Province mining laws are liberal.

The chief mine products are lode gold, lead, zinc, copper, silver, and coal; also placer gold, mercury, tungsten; and antimony, bismuth, cadmium, tin, and sulphur as by-products. Industrial minerals have been developed in only a small way.

## YUKON



**George Hanson**

*Assistant Chief Geologist Department of Mines and Resources, Ottawa*

GOLD PLACER MINING began in Yukon about 1880, but the production was small until 1886, when coarse gold was discovered on Forty-mile River, and from then until 1896, when placer gold was discovered in the Klondike field, the value of production ranged between $40,000 and $300,000 a year. The Klondike discovery led to a placer gold production from Yukon of $2,500,000 in 1897; $10,000,000 in 1898; and a peak of $22,275,000 in 1900. It showed a steady decrease for the next several years and in 1935 it reached a total of $1,256,000. Since then dredging has brought the figure back to about $3,000,000 a year.

Production of copper from deposits at Whitehorse was commenced in 1900, but little or no production has been reported since 1920. Small shipments of silver-lead ore from Yukon were made as early as 1912; and following discoveries at Keno Hill in the Mayo area in 1919, the silver-lead output increased substantially. The total value of the silver and lead production in 1940 was approximately $1,000,000. Antimony and tungsten deposits have been known in Yukon for many years.

VIGNETTES OF THE FUTURE

# LATIN AMERICA

## BRAZIL

**Th. D. de Souza Santos,**

*Manager,*
*Usina de Chumbo de Apiai,*
*Sao Paulo*

BRAZIL, covering an area larger than that of continental United States, offers a wide field for development of the mineral industry. Only a small part of its resources is now being exploited. Production is still slight and unimportant, in spite of the increase shown during the past few years.

A point to be emphasized is that a large part of Brazilian mineral resources is not duplicated in the other countries of the Western Hemisphere. Diversification also is remarkable, as evidenced by the following list of products: diamonds, ores of manganese, iron, chromium, nickel, cobalt, bauxite; several non-metallics such as graphite, magnesite, mica, rock crystal and chrysotile asbestos; minor metal minerals such as rutile, monazite, and zirconite.

Production of these minerals can be considerably increased, particularly at this time when shortage of shipping has restricted normal exports.

It is true that difficulties of transportation and distance from the coast constitute a serious handicap to the exploitation of some mining districts. But several regions known to be potentially important in mineral resources are near to the coast and have every facility of transportation as well as of labor. The great need of the Brazilian mineral industry is more capital and more technologists, as both are scarce within the country.

Conditions arising out of the World War must certainly enchance the mineral resources of Brazil and lead to a greater interest in their exploitation. High prices for several commodities are encouraging development, and the country is certain to play a more important part in the mineral industry of the Western Hemisphere.

## VENEZUELA

**N. B. Knox**

*Director,*
*Institute of Geology,*
*Caracas*

THERE ARE TWO mineralized regions in Venezuela: the northern mountain range, an offshoot of the Andes; and the Guiana shield, south of the Orinoco River. This region, like the Canadian shield, is underlain principally by ancient gneisses and schists.

Except for oil, gold is the most important product of the country. Annual production averages 120,000 oz. Of this 95,000 comes from the mining district of El Callao, where production is from quartz veins. Placers are generally small and irregular.

Second in importance are the extensive iron ores of the Imataca range. They are quartzites containing hematite and magnetite, often of remarkable purity, similar in origin to the Brazilian itabirites. The El Pao deposit is under concession to the Bethlehem Steel Company and so far 60,000,000 tons of ore reserves have been measured. Some of the enriched ores contain more than 71 percent iron.

Venezuela has produced some copper from the Aroa mines, but the ore is not rich enough for the present high costs. There is also some red-bed mineralization in the Andes, but it is very sparse. Rich samples of cinnabar have been brought in from Carora and the Caura, but there is no extensive mineralized region.

The serpentines that intrude the rocks of northern Venezuela contain minor quantities of chromite, asbestos, and magnesite. Rich samples of the first mineral have been obtained in Paraguana. Asbestos has been found at Tinaquillo and has attracted some attention. Considerable development work was done during the last war and in the '20s on a magnesite deposit on the Island of Margarita.

In general, the northern region of the country is poorly mineralized. However, the southern shield area shows promise and great tracts of it are unexplored. Unfortunately, exploration is difficult and expensive.

High costs are a great detriment to mining. These have their origin in difficult transportation, a scarcity of skilled labor, and a controlled exchange. Ancillary costs such as administration, labor compensation, food, and building are also high.

## ARGENTINA

**Ross Field**

*Kelseyville, Calif.,*
*Formerly Mine Superintendent,*
*Sociedad Minera Pirquitas,*
*Buenos Aires*

MINING ACTIVITY in Argentina continues to increase, there being especial interest in tungsten and mica for export. Restricted imports of certain non-metallics such as barite and sulphur have caused increased interest and production of these products for national consumption.

The largest operation continues to be the Compania Minera Aguilar S. A., a subsidiary of St. Joseph Lead Co. This company's mine and mill, in the northern part of the province of Jujuy, treats 1,000 tons per day of lead-zinc ores.

North of the Aguilar mine the Sociedad Minera Pirquitas is producing 100 tons of metallic tin and around 100,000 troy ounces of silver monthly from vein and placer deposits. Work is nearing completion on a new dry-land movable concentrator designed to treat 2,500 cubic meters of low-grade placer ground daily. At present rate placer reserves are expected to last five years and vein reserves three.

Activity in tungsten mines in the Pampa ranges has shown a great increase. The largest mine of the Sominar group is treating 100 tons a day of 0.65 percent $WO_3$ ore and producing about 40 tons of concentrates per month. At least 25 small tungsten mines and prospects are producing from a few hundred kilos to several tons per month of concentrates.

Armines, Ltd., has brought into production a small vein-gold property in the province of La Rioja.

Work has been started on the development of a sulphur deposit in one of the volcanoes of the Andes near the western border of Argentina.

Next summer development is planned by Cia. Ferrocarrillera de Petroleo of Buenos Aires on a lead-zinc property in the territory of Chubut near the Chilean frontier. Here a strong vein some 15 ft. wide is traceable on the surface for 5,000 ft. Average of samples taken from a series of trenches show a content of 6.25 percent lead and 7 percent zinc.

Argentina has many other small metallic and non-metallic mining operations too numerous to mention in detail but including the following: asbestos, antimony, clays, barite, beryllium, bismuth, borax, lime, feldspar, fluorite, manganese, mica, salt, sodium sulphate, talc, gypsum, and vanadium.

## ECUADOR

**Enrique Coloma Silva**

*General Director of Mines, Quito*

ECUADOR has always been a mining country, having occupied an important place in the exploitation of gold and silver since the period of the Spanish domination, and in the production of gold since the times of the Incas.

The two most important mining companies in Ecuador are the South American Development Company and the Cotopaxi Exploration Company, both American. Their ores contain gold, silver, copper, and lead, and production during the year 1940 can be estimated as follows:

| South American Development Company | | Value in Dollars |
|---|---|---|
| Gold, oz. | 52,847.12 | $1,849,576.09 |
| Silver, oz. | 121,628.93 | 43,166.38 |
| Copper, lb. | 25,352.75 | 2,785.66 |
| Lead, lb. | 501,130.08 | 25,430.34 |

| Cotopaxi Exploration Company | | Value in Dollars |
|---|---|---|
| Gold, oz. | 19,182.34 | $543,390.77 |
| Silver, oz. | 90,165.58 | 31,439.05 |
| Copper, lb. | 3,028,766.95 | 297,263.66 |
| Lead, lb. | ..... | ..... |

Among the companies carrying out exploration of gold-bearing, silver-bearing, and copper-bearing zones are three American concerns: Scarloch Mines, Inc., Calera Exploration Company, and Zamora Mines Corporation; and three Ecuadorian: Concesion Minera de Sigchos, Concesion Minera de Pascuales, and Concesion Minera de Pilzhum. There are other companies and individuals exploiting mines and gold placers, which are very abundant in the country.

Ecuador contains gold, silver, copper, manganese, and sulphur deposits which have not been worked and which offer excellent prospects for the future.

The laws of the country concerning mining are very complete, and the government at the moment is following a policy offering all kinds of guarantees to capital, especially North American, for the development of mines in Ecuador.

## NICARAGUA

**Stanley M. Moos**

*Consulting Metallurgist, Managua*

PROGRESS in Nicaraguan gold mining can best be measured by figures showing gold exported during the past six years. In 1935 the value was only $566,771. In 1940 it was $5,757,922.

Two most important producers, accounting for over 50 percent of gold exported, are La Luz Mines, Ltd., and Neptune Gold Mining Company, both in northeastern Nicaragua, Department of Bluefields. This Department, with 535 gold mines officially registered, should show continued increase from the above-named and several smaller properties now opening up.

Active interest is now centered in the Chontales district of south-central Nicaragua, where four properties are producing steadily from modern milling plants and planning increased production. This district, with 365 gold mines registered, has several properties undergoing careful investigation with an eye toward mill installations.

Newest important plant in Nicaragua is the 150-ton, straight-cyanide mill being installed at El Limon mine of the Empresa Minera de Nicaragua, in the Department of Leon. Production should start in a few months.

Though many other countries have been closing their doors to foreign capital under unsettled war conditions, Nicaragua has been experiencing a small gold-mining boom during the past two years. Mining activity has been enchanced by a government encouraging foreign capital investment and taking a sincere interest in the development of Nicaragua's mineral resources. Under the stimulus of increased investigation, old properties are being reopened, and many will be developed for early production. Though gold is the only metal being produced at this time, deposits of other metals are known.

## COLOMBIA

**Forbes Wilson**

*Manager, Timmins Ochali Mining Co., Yaroumal—Antioquia*

COLOMBIA has retained its position as the leading gold-producing country in South America for nearly four centuries. In this time many large alluvial areas and a few lode mines have been in continuous operation in one form or another. For the past seven years gold production has steadily increased and amounted to 631,732 oz. in 1940, approximately 60 percent being derived from alluvial operations and the remainder from lode mines.

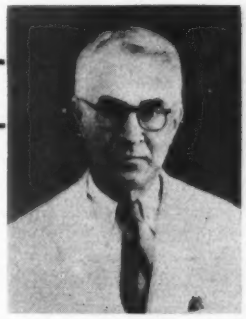
Platinum occurs in many of the streams on the Pacific side of Colombia ranging from Panama to Ecuador. At one time Colombia produced more than half the world's platinum. Its position today is of less importance, but

the amount produced has remained nearly constant. Practically all of the production at present comes from large-scale dredging operations in the State of Choco, on the San Juan River and its tributaries.

Mercury, molybdenum, antimony, copper, lead, and zinc have been reported from several scattered sources, but none of the elements mentioned has been produced on a commercial scale for any length of time. Several known deposits of hematite reasonably close to the Magdalena River and the Caribbean coast have possibilities of being exploited on a large scale.

The area of Colombia is greater than the combined areas of all the states on the Atlantic seaboard, but less than half of this area has been explored for mineral deposits. The Colombian government is continuing an active campaign of building roads into new areas, and this policy will undoubtedly result in new mineral discoveries of commercial importance.

## EL SALVADOR



**G. A. Swanquist**

*Minas Montecristo, Inc., San Miguel*

MINING IN EL SALVADOR has practically always been concentrated in the Eastern Oriente part of the republic, in the departments of San Miguel, La Union and Morazan.

There was a time when Butters Divisadero Company, operating the Divisadero mines, was the biggest mining enterprise in Central America, milling an average of about 350 tons per day. Next in tonnage was the Comacaran Gold Mining Company (Hormiguero et al mines), with 160 per day; then Butters Salvador Mines—the famous San Sebastian mine—with 100 tons; Monte Mayor, with 60; Tabanco and Encuentros mines with smaller tonnages. The grade of the ore varied. San Sebastian, carrying practically only gold, was a high-grade mine, with an average up to the close-down of around $30 per ton. The other mines were gold-silver, with combined values of from $7 to $10 and $12 per ton (gold at $20).

Due to various reasons—after-effects of the first World War; deeper mining, with additional costs; drop in the price of silver, etc.—all the mines mentioned closed down about the same time—about 1922-23.

About 1930 interest in mining was resumed, and with the increased value of gold has been further accelerated, but operations are carried on on a lower scale.

The present producing mines are: Minas Montecristo, Inc., with a modern, up-to-date plant, treating about 65 tons of gold-silver ore per day; Potosi, 40 to 45 tons, practically all gold; San Sebastian (all gold) and the Hormiguero, at about the same daily tonnage. Encuentros is producing on a smaller scale.

The future possibilities, if the present World War does not put a damper on the gold and silver mining, are very encouraging. Undoubtedly some of the old mines now closed down would be reopened and the prospect for opening up new mines in the departments mentioned, as well as in the Department of Cabañas, are considered to be very promising.

In the Department of Santa Ana, in the Metapan region, there are iron, copper, zinc, and lead deposits, which have been explored but not exploited to any important extent.

El Salvador, without doubt, has splendid gold and silver mining opportunities.

## PERU

**Clarence Woods**

*President Inca Mining and Development Co., Tirapata*

IN SOUTHEASTERN PERU the Santo Domingo mine, operated by North Americans since 1895, is the nucleus of an extensive development program. In 1932 the present operator discovered a mineralized zone 10 miles long and 1 mile wide, with the Santo Domingo mine near one end, the Montebello mine at the other, with the Macho Creek cutting the formation halfway between. Many veins of this zone, similar to Santo Domingo vein, carry fine gold.

In 1939 a 100-ton mill was erected at Montebello for a large tonnage of low-grade ore, containing high-grade stringers, which could be milled profitably. A 20-ton pilot mill has been erected on one of the six pay viens in the Macho Creek, 1,500 ft. lower than either Santo Domingo or Montebello.

With these three mines enough ore will be developed to justify a mill of 1,000 or more tons daily capacity. A crosscut tunnel will be run, about 9,000 ft. long, near the Macho Creek, and will cut this formation. The portal of this crosscut will be about 300 ft. above the Inambari River and the mill will be erected as soon as the truck-road, now building, from Limbani to Oroya, is completed.

What Peru needs more than anything else is men of the type who operated mines in the Western United States from 1890 to 1900—men who could go into the most isolated places, erect a sawmill, and soon have a complete mill and gold mine in operation and making money. There should still be such men of the pioneer type in the United States. They should come down here while the price of gold is still high, enrich themselves, and develop the country.

## MEXICO

**C. W. Vaupell**

*Mining Engineer, Mexico, D. F.*

MEXICAN MINING is at a low ebb because of labor troubles, high taxes, and interrupted marketing. Venture capital for mining, both Mexican and foreign, withdrew some years ago, and the established companies stopped exploration for new mines and confined their operations to salvaging whatever they could. There is promise that labor will take a more equitable attitude towards capital in Mexico. Mining taxes probably have reached or passed the point of diminishing returns, so some relief may be expected here also. American markets have been closed to Mexican ores and minerals by high tariffs except for gold, silver, and a few minor metals. While other markets are closed by war, Mexican base-metal miners mark time hoping that eventually some formula will be found enabling them to sell their products in the United States at a profit. If and

when this formula is found, Mexican production of lead, zinc, and copper will increase.

War demand has created a flurry for a few minor metals. Japan is taking increased amounts of mercury and fluorite at prices considerably higher than American prices. American buyers are in the market for manganese, antimony, fluorite, tungsten, tin, and cobalt. These buyers insist however on f.a.s. delivery, and as there is a dearth of venture money, the only notable production increases have been in antimony, fluorite, and manganese, whose ore is taken from outcrops and for which little capital investment is required.

Mexican tin production is sufficient for national consumption. The equipment for a new tin smelter to be built near the Federal District has been ordered; also, a small antimony smelter is under construction. Orders for two mercury furnaces have recently been placed with American concerns. The Monterrey Steel Company contemplates the building of a new blast furnace; and a small steel mill using scrap to make structural shapes has recently been installed at Mazatlán. The production of sheet mica is increasing and an attempt is being made to reopen gilsonite mines and markets.

Mexico has several very large high-grade iron-ore deposits near salt water on the Pacific slope for which there may be a market when a steel industry is established on the west coast. One very large alunite deposit exists near power, water, and rail, but nothing has been done with this as yet. Several low-grade deposits of bauxite, magnesite, and brucite have been reported. There is promise of future production from one very large tin placer, which is being sampled, and in several small cobalt prospects. Amorphous graphite production can be increased and very large diatomaceous earth deposits exist.

Mexican manufacturers are encountering difficulties in importing some mineral products the raw materials for which occur abundantly in the country. Studies are being made for the establishment of plants in the country to prepare fuller's earth, soda ash; zinc, lead, and antimony oxides; barium salts, sulphur, and phosphate fertilizers.

## CHILE

**T. R. Leighton**
*Mining Engineer, Santiago*

CHILE's main developed and undeveloped mineral resources are copper and nitrate. Commercially important copper deposits are known to exist from the northern Province of Tarapacá to a few hundred miles south of Santiago.

Nitrate occurrences accompanied by iodine compounds and other salts are restricted to the Provinces of Tarapacá and Antofagasta. Borax deposits also occur in this area.

Widespread rather small gold deposits are found near the coast all along Chile, the biggest mine treating about 11,000 tons of ore monthly. Silver mining belongs to the past, for pure silver mines are very few nowadays.

Some high-grade, high-purity, small iron deposits are found in the Provinces of Atacama and Soquimbo, and beach deposits of magnetite with titanium are common.

Small manganese deposits are scattered throughout the Province of Antofagasta to Santiago, the ores being generally low in impurities.

Mercury has been found to be associated with gold in the Punitaqui region. The country has a few small lead and zinc deposits scattered throughout its area, and a rather important lead deposit in the Patagonian region. Some small cobalt deposits are also found in several places. The main one at present is in the Freirina region, where there is a small concentrating plant. There are some low-grade molybdenum properties, and sometimes this metal accompanies the copper.

Some chrome-nickel samples taken near Concepción have been brought to Santiago. Tungsten ores are found in small scale in one place, and a vanadium bearing property is also known. Sulphur deposits exist on the slopes of extinct and active volcanoes, and are numerous all along the Chilean Andes.

## COSTA RICA

**Evan Bennett**
*Mining Engineer, San Jose*

COMMERCIAL mine production in Costa Rica is currently limited to gold. In 1940 this amounted to $569,910. Principal producer is the Abangarez concession. Also active are the Rudin mines, in the Miramar district; the Campañia and La Union, in the Aguacate; and several smaller operations. Explorations are being carried on by Canadian interests near Miramar. It is expected that the Pan American highway now being constructed to link Costa Rica and Panama will open up some promising country near the border, which has been all but inaccessible until now. The placers of Golfo Dulce and the Osa Peninsula have supported hundreds of gold washers, but dredging and hydraulicking have not passed the project stage.

Manganese in the Guanacaste area has been superficially investigated in the past year. These deposits produced several shipments of hand-sorted ore in the first World War. Sulphur deposits in Guanacaste have been the basis of sporadic promotion. Various occurrences of copper and lead are known, and will become interesting if prices of these metals should rise. A plant for custom treatment of gold concentrate is proposed.

Costa Rica remains an extraordinarily favorable country for small mining operations, from a political and economic standpoint. The government is stable and friendly to mining enterprises, particularly gold mines, as they help to stablilize the exchange. Geologically, little is known, and large sections of the Cordillera are unexplored. Gold occurs extensively associated with acid intrusives in Tertiary andesites.

## BOLIVIA

**P. H. Reagan**
*Mining Engineer, La Paz*

METALLURGISTS have a wonderful opportunity awaiting them in Bolivia. Tin milling continues to use the gravity methods for the recovery of the metal. Recovery in the

more efficient mills is 80 percent, and the poorer mills probable secure 50 percent or less. Tin is worth 50c. a pound. There are millions of tons of old tailings, mine dumps, and stope fillings which will assay 0.6 percent tin or better; in some cases as high as 2 percent. The value of this material is at least $6 per ton, and the recovery of this metal offers an opportunity for the metallurgists who can solve the problem.

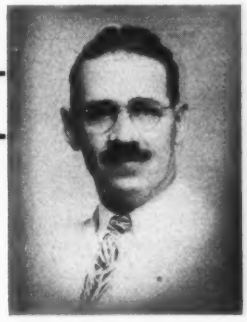
The world depression resulted in the United States developing the dragline and floating washing plant for small gold placers where capital investment must be kept to the minimum. Bolivia contains many such deposits, with tin as the principal metal and with gold, tungsten, or bismuth as secondary metals. A few of these deposits have been drilled, but the majority have had only one or two holes sunk, enough to indicate that values exist.

Tungsten mining and milling is, comparatively speaking, a new business. Previously, few cared to enter this business, because of violent price fluctuations. The signing of the contract with the United States, providing a fixed price of $1.05 per pound of contained $WO_3$ for the high-grade material, and favorable prices for lower grades, over a period of years, eliminates the past hazards of price fluctuations. Tungsten milling, like tin milling, makes recoveries of approximately 50 percent to 70 percent in the better mills. Many small tungsten properties are available. Capital must realize, however, that these properties will not have any blocked-out ore reserves. The small miner in Bolivia mines his ore as fast as it is developed. The future of these mines must be judged by their geological conditions.

## HONDURAS

**Paul H. Hale**

*Woodside, L. I., Formerly General Manager, Cia. Minera Agua Fria, Tegucigalpa*



THE DEVELOPED MINERAL RESOURCES of Honduras are chiefly in gold and silver. Production amounted to 39,000 oz. gold and 4,106,000 oz. silver during the 1939–1940 period. The sources of this production are:

First, the long-productive New York & Honduras Rosario mine, with a mill of 550 tons' daily capacity and annual production of approximately 20,000 oz. gold and 4,000,000 oz. silver. A large vein system successfully developed in advance of current production requirements has insured this mine of ample reserves and many years' production.

Second, the Agua Fria mine, near Danli, operating mine and flotation mill of 125 tons' daily capacity, with annual production of 12,000 oz. gold and 16,000 oz. silver. In spite of continued exploratory efforts, ore reserves are rapidly becoming depleted and the life of this mine appears to be limited.

Third, the native-worked river and stream placers, which are found in many widely scattered parts of Honduras. For centuries the natives have panned the "playas" of streams and rivers for their gold, but to date unfavorable conditions in the known placers have prevented large-scale operations.

The potentialities of the undeveloped mineral resources of Honduras are unpredictable, because the known mineral districts have never been thoroughly explored and because there are vast uninhabited sections of virgin country which have never been penetrated. Airplane transportation, with landing fields established in many formerly remote sections, and rapidly extending automobile highways, have removed the former transportation obstacle which prevented serious exploration.

Well-organized and competent geological parties have made extensive examinations in various parts of Honduras during the last few years, with some encouraging results. In addition to the interest shown in gold and silver prospects, locations showing antimony, quicksilver, manganese, and tin have been under investigation in various parts of the country. None of these discoveries has yet proved to be of commercial importance.

## NICARAGUA

**Frank Cameron**

*General Manager, La Luz Mines, Ltd., Siuna*

THE MINING INDUSTRY OF NICARAGUA consists almost entirely of mining gold ores with which silver is associated. Both open-cut and underground mining methods are used, although a small amount of gold is recovered by individuals who wash the sands in old creek and river beds.

Much of the interior of Nicaragua is mountainous, covered with virgin forest cut by many rivers which swell to torrents during the six months of rainy season. Lack of transportation is, therefore, the great handicap in opening up and operating mines on large tonnages. There is but one railroad, running from Managua to Corinto, the principal port on the west coast, and little road building had been done until recently, when work was begun on the International Highway.

Transportation by airplane began in 1932, and because of that freight service, the construction and operation of larger plants has become possible. Taca, which handles all air freight and passenger service to the various mines, carries more freight than any other individual aviation company in the world. To one of the largest mines here Taca will deliver in 1941 more than 13,000,000 lb.

The principal mining districts are Madriz, Leon, Chontales, and Matagalpa.

In Madriz are located the Neptune Gold Mining Company and La Luz Mines, Ltd., at a distance of about 160 miles northeast of Managua. These mines are accessible only to airplanes but have accounted for 55 percent of the entire gold production for 1940.

In Leon, approximately 60 miles northwest of Managua, are two mining properties, La India and El Limon mines. La India accounted for 22 percent of the national 1940 gold production; El Limon is a new discovery and came into production in July of this year. These mines can be reached by road in the dry season but can be reached only by airplane during the wet months.

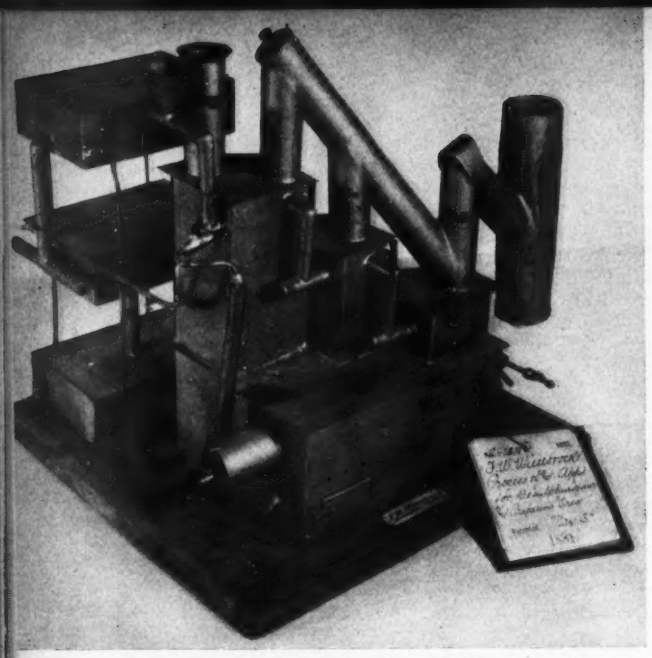
Chontales is probably the oldest gold mining district in Nicaragua, containing the Jabali mine, which has been operating for more than 60 years. This district is 78 miles east of Managua and is accessible by road.

Matagalpa district is 75 miles northeast of Managua. La Reina is the principal gold producer in this area.

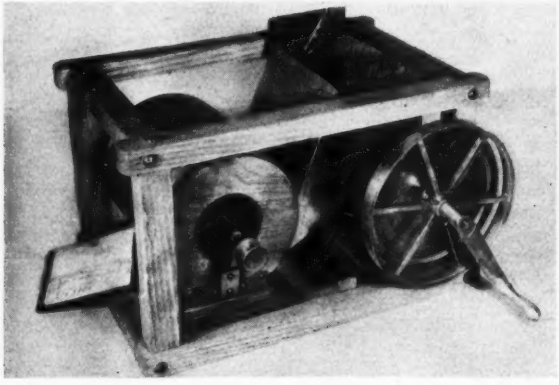
The importance of Nicaraguan gold mining can be well understood if compared with the country's coffee production, which until 1939 had been the country's greatest industry. The average value of the coffee crop during the last eleven years is $2,560,000. The coffee crop for 1940 grossed $2,093,952. As the estimated gold production for 1941 is $8,000,000, the mining industry will be three times as valuable to the country this year as the average coffee crop has been over the past eleven years.

# Patent Models

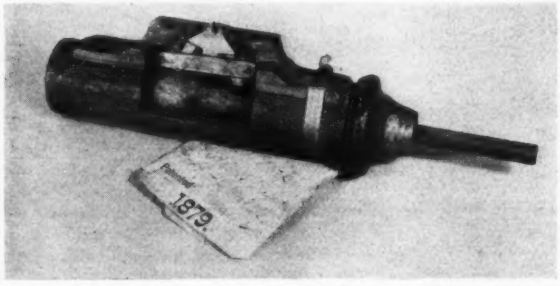
UP TO 1880 the Patent Office required applicants for patents to submit mechanical models illustrating their inventions. By that time models were accumulating so rapidly as to present a problem in housing. So the policy of requiring models was abandoned, and the accumulation was boxed and stored. By 1925, however, space and expense for



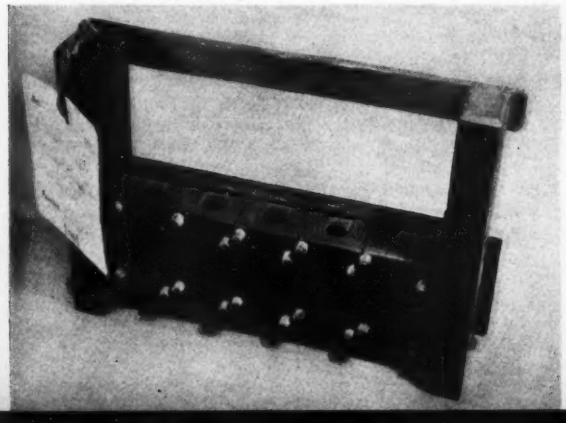
Above: 241,108. May 3, 1881. F. W. Wiesebrock. Process of and apparatus for desulphurizing and preparing ores.

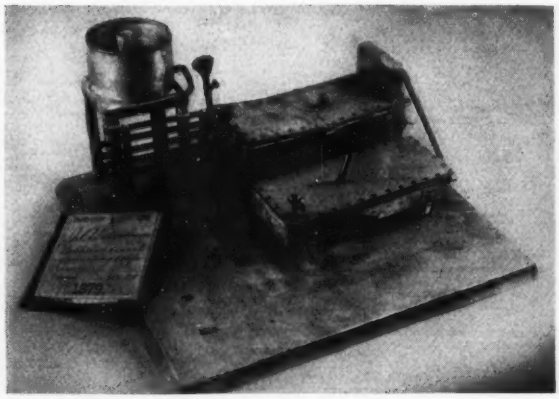


215,290. March 3, 1879. P. Plant. Ore separators.

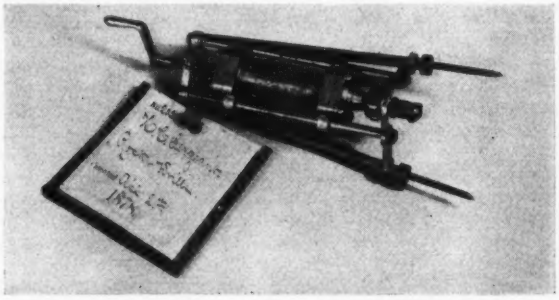


215,152. May 6, 1878. T. J. Murphy. Sliding valve for rock drills.

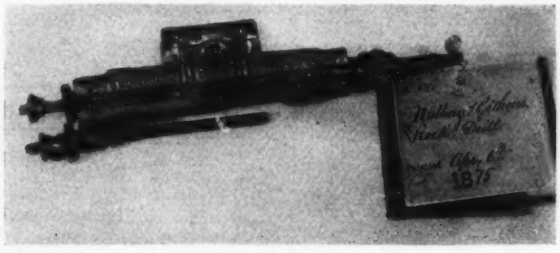




221,990. Nov. 25, 1879. J. Absterdam. Vacuum amalgamating apparatus.



202,060, April 2, 1878. H. C. Sergeant. Rock Drill.

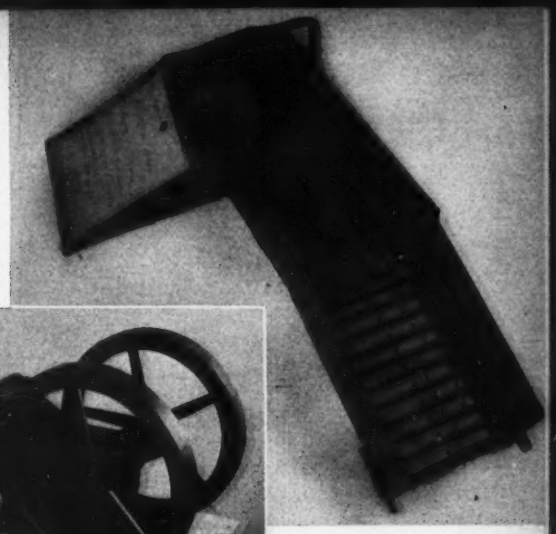


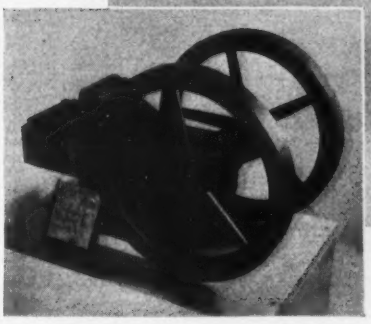
161,631. April 6, 1875. Nutting and Githens. Steam Rock drill.

Left: 245,548. Aug. 9, 1881. David Nevin. Stamp guide for ore mills.

# of Yesterday

storage led Congress to authorize the sale of the models. They are now in possession of American Patent Models, Inc., 630 Fifth Ave.. New York City, where about ten percent of them are on exhibition. It was from this display that the photographs on these pages were made available by courtesy of the owners.





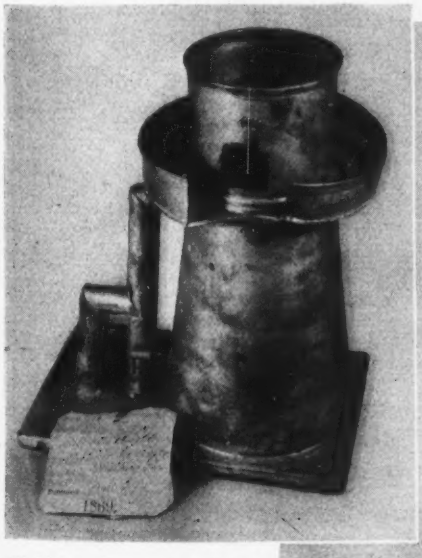
130,658. Aug. 20, 1872. Joseph Potts. Electro-galvanic quicksilver and amalgam saving apparatus.

27,882. April 17, 1860. Eli W. Blake. Machine for breaking stones.

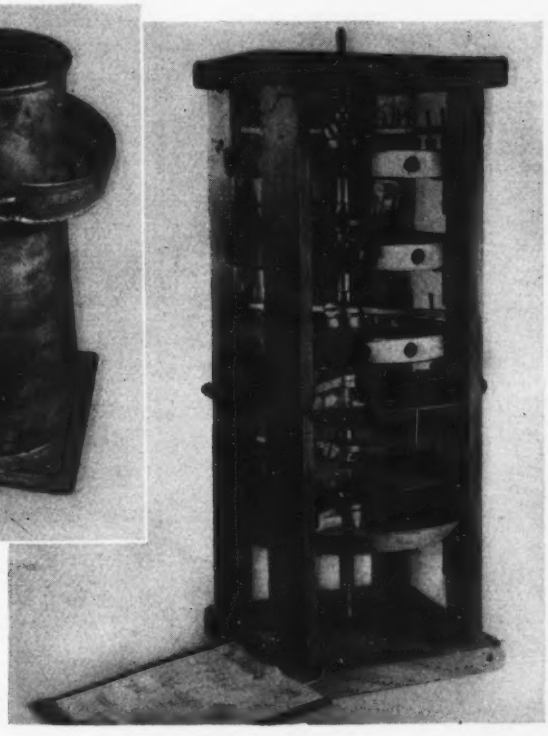
28,662. June 12, 1860. P. Estes. Quartz crushers or mills. Right: 28,807. June 19, 1860. Gates and Fraser. Machine for stamping metal quartz.

208,448. Sept. 24, 1878. E. S. Winchester. Rock drill.

180,620. Aug. 1, 1876. Fidile Motte. Crushing machine.



92,006. June 29, 1869. Brannon and Baldwin. Collecting the waste gases of smelting furnaces.



Right: 215,290. Feb. 4, 1879. P. Plant. Ore separator.

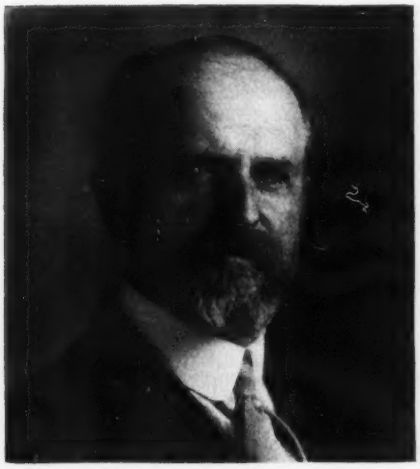
Right: 211,772. Jan. 28, 1879. D. J. O'Harra. Apparatus for washing chloridized ores.

# THE EDITORS OF E. & M. J.

Of the nine editors who have directed the fortunes of *Engineering and Mining Journal,* five survive. Of the other four—Dawson, Raymond, Rothwell, and Day—we have ample record except in the case of George Francis Dawson, first editor of *American Journal of Mining,* immediate predecessor of *E.&M.J.* Little is known of his antecedent or later activity. Of the surviving group T. A. Rickard and J. E. Spurr have retired, the former living in Victoria, B. C., and the latter dividing his time between Winter Park, Fla., and Alstead, N. H. Walter Renton Ingalls is director of the American Bureau of Metal Statistics, New York, and A. W. Allen is a consulting metallurgist, San Jose, Costa Rica.

**ROSSITER W. RAYMOND** was editor from 1867 to 1874, and thereafter co-editor with Richard P. Rothwell until 1889. He was the great publicist of the mining fraternity, an accomplished speaker of impressive personality. He was active in founding the A.I.M.E. in 1871, was president 1872–1874, and secretary from 1884 to 1911.

**GEORGE FRANCIS DAWSON** was the first editor of *American Journal of Mining,* serving from March 31, 1866, to March 23, 1867. His "Salutatory," to be found on page six of the accompanying reproduction of the first issue, gave early promise of high editorial standards and modest determination to succeed. Diligent search has failed to discover his portrait or a clue to his later career.



**DAVID T. DAY** was editor from 1901 to 1902. His contemporaries agree that his brief association with the *Journal* was almost nominal, and that he soon retired to devote his time to work for which he was well fitted. His career of 28 years in the U.S.G.S. earned for him the sobriquet of "father of the Mineral Research Division."

**RICHARD P. ROTHWELL** was co-editor with Rossiter W. Raymond from 1874 to 1889, and thereafter editor until 1901. Established *E.&M.J.* in its early reputation as a journal of mining economics and technology. He was an active sponsor of the A.I.M.E. in 1871, and was president in 1882.

**T. A. RICKARD** was editor from 1903 to 1905. He enlisted the financial interest of a large group of mining engineers in the company then controlling the *Journal* editorially. He promoted lively discussion of technical topics, notably on ore deposits, mine sampling, and pyrite smelting.

**WALTER RENTON INGALLS** was editor from 1905 to 1919. He inherited from Rothwell the statistical and economic traditions of the *Journal*, and developed the method of market reporting that gained world-wide acceptance for *"E.&M.J.* metal prices." During his editorship the technical scope of the *Journal* was broadened to such an extent that it became advisable to abandon attention to coal mining, and create *Coal Age* for that branch of the industry.

**J. E. SPURR** was editor from 1919 to 1927. Following the World War he sensed the importance of the international aspects of the mining industry and reflected that conviction in the pages of the *Journal.* He expanded the market reporting service of the *Journal,* and publicized the marketing of metals and minerals. His personal contributions to the *Journal* on geological subjects attracted the special interest of the profession.

**A. W. ALLEN** was editor from 1927 to 1933. He inaugurated the series of special issues of the *Journal* devoted to single great mining enterprises and to important mining areas. During his editorship the frequency of publication changed from weekly to monthly and he launched *E.&M.J. Metal and Mineral Markets* as a weekly market information and metal price service.

**H. C. PARMELEE,** editor since 1933.

*Summary of the*

# MARKETS

COMPLETE CONTROL by OPM over distribution of copper in the United States became effective Aug. 6. This move was thought necessary to regulate the flow of copper to provide for ever-increasing defense needs and to keep the disappearance of metal for civilian use in check. Producers should experience no great difficulty in switching to the new regulations, the trade believes, but consumers not engaged in defense work may find themselves embarrassed.

Owing largely to a flurry in tin prices, growing out of tension in the Far East, the *E&MJ* index of non-ferrous metal prices for July advanced moderately to 83.60. A month previous the index stood at 83.51.

Estimated copper content of shipments by mills and foundries, usually accepted as consumption, amounted to 136,000 tons during June, a new monthly high, the American Bureau of Metal Statistics reports. Shipments over the first half of 1941 totaled 781,000 tons, against 420,500 tons in the Jan.-June period of 1940.

Sales of duty-free copper to domestic consumers during July amounted to 100,396 tons, which compares with 80,143 tons in June. The bulk of the business was booked at the producers' quotation of 12c., Valley. Custom smelters and some small producers obtained 12¼c.

Arrangements to buy 225,000 tons of foreign lead were concluded by the Metals Reserve Company. The price paid was 3.75c., exclusive of duty, Laredo, Texas, and Trail, British Columbia. The bulk of the tonnage will originate in Mexico. This lead was purchased to relieve the domestic market and will be distributed "at the market," or basis 5.85c., New York.

The emergency zinc pool for August was raised to 27 percent of production, against 22 percent for July. The price situation in zinc was unchanged.

Tin consumers were warned by officials in Washington against bidding up prices. A price ceiling was considered to check the advance.

Quicksilver advanced on increased consumption. Antimony was quite active.

## UNITED STATES MARKET

| 1941 July | Electrolytic Copper: Domestic (a) Refinery | Electrolytic Copper: Export (b) Refinery | Straits Tin: New York | Lead: New York | Lead: St. Louis | Zinc: St. Louis |
|---|---|---|---|---|---|---|
| 1 | 11.825 | 10.950 | 52.750 | 5.85 | 5.70 | 7.25 |
| 2 | 11.800 | 10.950 | 52.750 | 5.85 | 5.70 | 7.25 |
| 3 | 11.825 | 10.950 | 52.875 | 5.85 | 5.70 | 7.25 |
| 4 | Holiday | 10.950 | | Holiday | | |
| 5 | 11.775 | 10.950 | 53.000 | 5.85 | 5.70 | 7.25 |
| 7 | 11.800 | 10.950 | 53.000 | 5.85 | 5.70 | 7.25 |
| 8 | 11.850 | 10.950 | 53.000 | 5.85 | 5.70 | 7.25 |
| 9 | 11.800 | 10.950 | 53.250 | 5.85 | 5.70 | 7.25 |
| 10 | 11.775 | 10.950 | 53.250 | 5.85 | 5.70 | 7.25 |
| 11 | 11.775 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 12 | 11.775 | 10.950 | 53.625 | 5.85 | 5.70 | 7.25 |
| 14 | 11.825 | 10.950 | 53.625 | 5.85 | 5.70 | 7.25 |
| 15 | 11.800 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 16 | 11.775 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 17 | 11.900 | 10.950 | 53.250 | 5.85 | 5.70 | 7.25 |
| 18 | 11.875 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 19 | 11.775 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 21 | 11.825 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 22 | 11.900 | 10.950 | 53.625 | 5.85 | 5.70 | 7.25 |
| 23 | 11.800 | 10.950 | 53.375 | 5.85 | 5.70 | 7.25 |
| 24 | 11.850 | 10.950 | 54.125 | 5.85 | 5.70 | 7.25 |
| 25 | 11.850 | 10.950 | 55.250 | 5.85 | 5.70 | 7.25 |
| 26 | 11.775 | 10.950 | 55.250 | 5.85 | 5.70 | 7.25 |
| 28 | 11.800 | 10.950 | 55.000 | 5.85 | 5.70 | 7.25 |
| 29 | 11.775 | 10.950 | 54.000 | 5.85 | 5.70 | 7.25 |
| 30 | 11.775 | 10.950 | 53.000 | 5.85 | 5.70 | 7.25 |
| 31 | 11.800 | 10.950 | 52.250 | 5.85 | 5.70 | 7.25 |
| **AVERAGES FOR MONTH** | | | | | | |
| July | 11.812 | [10.950 | 53.481 | 5.850 | 5.700 | 7.250 |
| **AVERAGES FOR WEEK** | | | | | | |
| 2 | 11.800 | 10.950 | 52.833 | 5.850 | 5.700 | 7.250 |
| 9 | 11.810 | 10.950 | 53.025 | 5.850 | 5.700 | 7.250 |
| 16 | 11.788 | 10.950 | 53.438 | 5.850 | 5.700 | 7.250 |
| 23 | 11.846 | 10.950 | 53.396 | 5.850 | 5.700 | 7.250 |
| 30 | 11.804 | 10.950 | 54.438 | 5.850 | 5.700 | 7.250 |
| **CALENDAR WEEK AVERAGES** | | | | | | |
| 5 | 11.805 | 10.950 | 52.850 | 5.850 | 5.700 | 7.250 |
| 12 | 11.796 | 10.950 | 53.250 | 5.850 | 5.700 | 7.250 |
| 19 | 11.825 | 10.950 | 53.396 | 5.850 | 5.700 | 7.250 |
| 26 | 11.833 | 10.950 | 54.167 | 5.850 | 5.700 | 7.250 |

## SILVER, GOLD AND STERLING EXCHANGE

| 1941 July | Sterling Exchange: "Checks" (Nominal) | Sterling Exchange: "90-day demand" | Silver (c): New York | Silver (c): London | Gold: London | Gold (d): United States |
|---|---|---|---|---|---|---|
| 1 | 401.000 | (f) | 34.750 | 23.3750 | 168s | $35.00 |
| 2 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 3 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 4 | Holiday | Holiday | Holiday | 23.3750 | 168s | Holiday |
| 5 | 401.000 | (f) | (e) | (e) | (e) | 35.00 |
| 7 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 8 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 9 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 10 | 401.000 | (f) | 34.750 | 23.2500 | 168s | 35.00 |
| 11 | 401.000 | (f) | 34.750 | 23.2500 | 168s | 35.00 |
| 12 | 401.000 | (f) | (e) | (e) | (e) | 35.00 |
| 14 | 401.000 | (f) | 34.750 | 23.3125 | 168s | 35.00 |
| 15 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 16 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 17 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 18 | 401.000 | (f) | 34.750 | 23.3750 | 168s | 35.00 |
| 19 | 401.000 | (f) | (e) | (e) | (e) | 35.00 |
| 21 | 401.000 | (f) | 34.750 | 23.4375 | 168s | 35.00 |
| 22 | 401.000 | (f) | 34.750 | 23.4375 | 168s | 35.00 |
| 23 | 401.000 | (f) | 34.750 | 23.4375 | 168s | 35.00 |
| 24 | 401.000 | (f) | 34.750 | 23.5000 | 168s | 35.00 |
| 25 | 401.000 | (f) | 34.750 | 23.4375 | 168s | 35.00 |
| 26 | 401.000 | (f) | (e) | (e) | (e) | 35.00 |
| 28 | 401.000 | (f) | 34.750 | 23.4375 | 168s | 35.00 |
| 29 | 401.000 | (f) | 34.750 | 23.5000 | 168s | 35.00 |
| 30 | 401.000 | (f) | 34.750 | 23.5000 | 168s | 35.00 |
| 31 | 401.000 | (f) | 34.750 | 23.5000 | 168s | 35.00 |
| **AVERAGES FOR MONTH** | | | | | | |
| July | 401.000 | ..... | 34.750 | 23.397 | ..... | 35.00 |
| **AVERAGES FOR WEEK** | | | | | | |
| July | | | | | | |
| 2 | 401.000 | ..... | 34.750 | ..... | ..... | ..... |
| 9 | 401.000 | ..... | 34.750 | ..... | ..... | ..... |
| 16 | 401.000 | ..... | 34.750 | ..... | ..... | ..... |
| 23 | 401.000 | ..... | 34.750 | ..... | ..... | ..... |
| 30 | 401.000 | ..... | 34.750 | ..... | ..... | ..... |

Calendar week averages, New York Silver: July 5th, 34.750; 12th, 34.750; 19th, 34.750; 26th, 34.750.

(e) Not quoted (Saturday). (f) No quotation.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotations deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade Zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout July.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

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## LONDON MARKET

| July, 1941 | Tin Standard Spot | Tin Standard 3 months |
|---|---|---|
| 1 | 256.5000 | 260.5000 |
| 2 | 256.5000 | 260.7500 |
| 3 | 258.5000 | 262.2500 |
| 4 | 261.0000 | 263.7500 |
| 7 | 258.5000 | 262.0000 |
| 8 | 257.2500 | 260.7500 |
| 9 | 256.7500 | 260.5000 |
| 10 | 257.2500 | 261.0000 |
| 11 | 258.7500 | 261.5000 |
| 14 | 258.5000 | 261.2500 |
| 15 | 257.7500 | 261.2500 |
| 16 | 256.7500 | 260.2500 |
| 17 | 257.5000 | 260.2500 |
| 18 | 258.5000 | 261.7500 |
| 21 | 259.0000 | 262.0000 |
| 22 | 259.0000 | 261.7500 |
| 23 | 258.2500 | 261.0000 |
| 24 | 259.7500 | 262.7500 |
| 25 | 261.0000 | 263.5000 |
| 28 | 261.0000 | 262.7500 |
| 29 | 258.5000 | 260.5000 |
| 30 | 257.0000 | 259.7500 |
| 31 | 256.7500 | 259.7500 |
| Average | 258.272 | ..... |

Official tin prices on London Metal Exchange in long tons, pound sterling. Trading in copper, lead, and zinc suspended August 31. 1939.


## Weekly MARKET INFORMATION Service

- E&MJ Metal & Mineral Markets, the weekly price information service of Engineering & Mining Journal, will keep you in close touch with effects of war developments on costs and availability of metals and non-metallic minerals.
- Printed and mailed every Wednesday night, E&MJ Metal & Mineral Markets will speed to you as special newspaper mail. It carries daily and weekly average prices of metals for the preceding six market days.
- Rates: $5 a year in the United States and possessions, and in the Americas; $10 a year elsewhere. Address:

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## CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

**Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated**

(Aug. 1, 1941)

### MISCELLANEOUS METALS

| | |
|---|---|
| **Aluminum,** ingot, 99 plus per cent, lb | 17c. |
| **Antimony,** domestic, spot, lb | 14.00c. |
| **Bismuth,** ton lots, lb | $1.25 |
| **Cadmium,** commercial sticks, lb | 90c. |
| **Calcium,** lb., ton lots 97 @ 98 per cent | Nominal |
| **Chromium,** 97 per cent grade, lb | 89c. |
| **Cobalt,** 97 to 99 per cent, per lb | $1.50 |
| **Nickel,** electrolytic cathodes, lb | 35c. |
| **Magnesium,** 99.8 per cent, carloads, lb | 27c. |
| **Palladium,** troy oz | $24.00 |
| **Platinum,** (Official quotation) troy oz | $36.00 |
| **Quicksilver,** flask of 76 lb., 100 flasks or more | $192.00 |
| **Radium,** mg. radium content | $25.00@$30.00 |
| **Selenium,** 99.5 per cent, lb | $1.75 |
| **Silicon,** minimum 97 per cent, spot, lb | 16.50c. |
| **Tellurium,** lb | $1.75 |
| **Thallium,** 100 lb. or more, lb | $10.00 |
| **Titanium,** 96 to 98 per cent, lb | $5.00 |

### METALLIC ORES

| | |
|---|---|
| **Beryllium Ore,** f.o.b. mines, ton | $30.00@$35.00 |
| **Chrome Ore,** 48 @ 50% $Cr_2O_3$ c.i.f. Atl. ports, long ton | (b)$43.00@$45.00 |
| **Iron Ore,** Lake Superior, Lower Lake ports, long ton: | |
| Old Range bessemer | $4.75 |
| Mesabi bessemer | $4.60 |
| Old Range non-bessemer | $4.60 |
| Mesabi, non-bessemer | $4.45 |
| **Lead** (Galena) 80 per cent, Joplin, Mo., ton | $69.58 |
| **Manganese Ore,** (foreign) c.i.f. U.S. ports, long ton unit of Mn: | |
| 52 @ 55 per cent | (b) 70c. |
| 50 @ 52 per cent | (b) 70c. |
| 46 @ 48 per cent | (b) 65c. |
| **Molybdenum Ore,** 90%, per lb. of $MoS_2$, f.o.b. mines | 45c. |
| **Tungsten Ore,** per unit of $WO_3$: | |
| Chinese, 65 per cent, duty paid | (b) $24.00 |
| Domestic, 65 per cent and upward | (a) $23.50 |
| **Vanadium Ore,** per lb. of contained $V_2O_5$ | 27½c. |
| **Zinc Ore,** Prime, 60 per cent concentrate, Joplin, Mo.; per ton | $48.00 |

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

### METALLIC COMPOUNDS

| | |
|---|---|
| **Arsenious Oxide** (arsenic) lb | 4c. |
| **Cobalt Oxide,** 70 @ 71 per cent, lb | $1.84 |
| **Copper Sulphate,** 100 lb | $4.75 |
| **Sodium Nitrate,** ex vessel, in 200-lb. bags, per 100 lb | $1.43 |
| **Sodium Sulphate,** bulk ton | $18.00@$24.00 |

### ALLOYS

| | |
|---|---|
| **Beryllium Copper,** master alloy, 2.5 to 3 per cent Be, per lb. of contained Be | $15.00 |
| **Ferrochrome,** 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained | 11c. |
| **Ferromanganese,** 78 @ 82 per cent, gross ton | $120.00 |
| **Ferromolybdenum** 55 @ 65 per cent Mo. lb. of Mo. contained | 95c. |
| **Ferrosilicon,** 50 percent, gross ton | $74.50 |
| **Ferrotungsten,** 75 @ 80 per cent, lb. of W contained | $1.90@$2.00 |
| **Ferrovanadium,** per lb. of V, delivered | $2.70@$2.90 |

### NON-METALLIC MINERALS

| | |
|---|---|
| **Asbestos,** f.o.b. Canadian (Quebec) mines (U.S. funds), ton; | |
| Crude No. 1 | $700@$750 |
| Crude No. 2 | $150@$350 |
| Spinning fibers | $110@$200 |
| Paper stock | $40@$49.50 |
| Shorts | $13@$17.50 |
| Vermont, f.o.b. Hyde Park: | |
| Shingle stock | $57.00@$60.00 |
| Paper stock | $40.00@$48.00 |
| Shorts | $13.00@$26.00 |
| Floats | $18.00 |
| **Barytes,** long ton: | |
| Georgia, crude | $8.00 |
| Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron | $6.00@$6.50 |
| **Bauxite,** long ton: | |
| Domestic, crude, 50 @ 52 percent (not dried) | $5.00 |
| Domestic, chemical, 55 @ 58 per cent | $7.00@$8.00 |
| Domestic, abrasive, 80 @ 84 per cent | $16.00 |
| **China Clay,** f.o.b. mines, ton: | |
| South Carolina and Georgia, No. 1, bulk | $6.75@$8.00 |
| Delaware, No. 1 | $14.50 |
| **Feldspar,** bulk, ton: | |
| Potash feldspar, 200 mesh | $17.00 |
| Glass-spar, white, 20 mesh | $11.75 |
| **Fluorspar,** f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton | $21.00 |
| Ground, 95 @ 98 percent, bulk, ton | $31.00 |
| Lump, acid, 98 percent, bulk, ton | $27.00 |
| **Fuller's earth,** f.o.b. Georgia or Florida, ton | $7.00@$14.00 |
| **Magnesite,** per ton: | |
| Dead-burned, f.o.b. California | $25.00 |
| Dead-burned, f.o.b. Washington | $22.00 |
| **Mica,** per lb., North Carolina, No. 1 and 2 quality: | |
| 1¼ x 2 in. | 45@60c. |
| 2 x 2 in. | 60@80c. |
| 3 x 3 in. | $1.25@$1.50 |
| 3 x 4 in. | $1.50@$1.75 |
| 3 x 5 in. | $1.75@$2.25 |
| White, ground, 70 mesh, ton | $60.00@$80.00 |
| **Ocher,** Georgia, ton | $19.00@$22.00 |
| **Pyrites,** Spanish, per long ton unit of S, c.i.f. Atlantic ports | (a) 12c |
| **Silica,** in bags, 325 mesh, ton | $20.00@$40.00 |
| **Sulphur,** Texas, mines, long ton | $16.00 |
| **Talc,** f.o.b. works, ton: | |
| New York, double air-floated, 325 mesh | $12.00@$15.00 |
| New Jersey, mineral pulp | $8.50@$10.50 |
| Vermont, extra white, 200 mesh | $9.50@$10.00 |
| **Tripoli,** Missouri, ton: | |
| 40 mesh, cream colored | $14.50 |
| 200 mesh, cream colored | $26.00 |

(a) Nominal

### IRON AND STEEL

| | |
|---|---|
| **Pig Iron,** Valley furnaces, gross ton: | |
| Bessemer | $24.50 |
| Basic | $23.50 |
| No. 2 Foundry | $24.00 |
| **Steel,** base prices, Pittsburgh: | |
| Billets, gross ton | $34.00 |
| Structural shapes, 100 lb | $2.10 |
| Bars, 100 lb | $2.15 |

*Monthly and Yearly*

# AVERAGE PRICES

## SILVER AND STERLING EXCHANGE

| | New York | | London Spot | | Sterling Exchange | |
|---|---|---|---|---|---|---|
| | 1940 | 1941 | 1940 | 1941 | 1940 | 1941 |
| January | 34.750 | 34.750 | 21.892 | 23.273 | 395.442 | (a) 402.000 |
| February | 34.750 | 34.750 | 20.935 | 23.341 | 395.652 | (a) 401.864 |
| March | 34.750 | 34.750 | 20.763 | 23.446 | 375.212 | (a) 401.788 |
| April | 34.750 | 34.750 | 20.713 | 23.500 | 351.817 | (a) 401.058 |
| May | 34.949 | 34.750 | 21.878 | 23.457 | 326.452 | (a) 400.981 |
| June | 34.825 | 34.750 | 22.688 | 23.400 | 359.560 | (a) 401.000 |
| July | 34.750 | 34.750 | 22.095 | 23.397 | 379.750 | (a) 401.000 |
| August | 34.750 | ..... | 23.261 | ..... | 396.889 | ..... |
| September | 34.750 | ..... | 23.446 | ..... | 401.646 | ..... |
| October | 34.750 | ..... | 23.451 | ..... | 401.692 | ..... |
| November | 34.750 | ..... | 23.238 | ..... | 401.783 | ..... |
| December | 34.750 | ..... | 23.015 | ..... | 402.000 | ..... |
| Year | 34.773 | ..... | 22.281 | ..... | 382.325 | ..... |

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents. (a) Nominal.

## COPPER

| | F.O.B. Refinery, Electrolytic | | | |
|---|---|---|---|---|
| | Domestic | | Export | |
| | 1940 | 1941 | 1940 | 1941 |
| January | 11.954 | 11.819 | 11.999 | 10.257 |
| February | 11.148 | 11.794 | 11.471 | 10.414 |
| March | 11.160 | 11.814 | 11.407 | 10.592 |
| April | 11.087 | 11.820 | 11.258 | 10.952 |
| May | 11.079 | 11.815 | 11.191 | 10.950 |
| June | 11.128 | 11.810 | 11.216 | 10.950 |
| July | 10.564 | 11.812 | 10.189 | 10.950 |
| August | 10.708 | ..... | 9.351 | ..... |
| September | 11.296 | ..... | 9.849 | ..... |
| October | 11.826 | ..... | 10.436 | ..... |
| November | 11.800 | ..... | 10.084 | ..... |
| December | 11.802 | ..... | 10.293 | ..... |
| Year | 11.296 | ..... | 10.770 | ..... |

New York quotations, cents per pound.

## LEAD

| | New York | | St. Louis | |
|---|---|---|---|---|
| | 1940 | 1941 | 1940 | 1941 |
| January | 5.471 | 5.500 | 5.321 | 5.350 |
| February | 5.076 | 5.602 | 4.926 | 5.452 |
| March | 5.192 | 5.765 | 5.042 | 5.613 |
| April | 5.071 | 5.850 | 4.921 | 5.700 |
| May | 5.015 | 5.850 | 4.865 | 5.700 |
| June | 5.000 | 5.850 | 4.850 | 5.700 |
| July | 5.000 | 5.850 | 4.850 | 5.700 |
| August | 4.854 | ..... | 4.704 | ..... |
| September | 4.929 | ..... | 4.779 | ..... |
| October | 5.308 | ..... | 5.158 | ..... |
| November | 5.726 | ..... | 5.578 | ..... |
| December | 5.500 | ..... | 5.350 | ..... |
| Year | 5.179 | ..... | 5.029 | ..... |

New York and St. Louis quotations, cents per pound.

## TIN

| | Straits New York | | Standard, Spot London | |
|---|---|---|---|---|
| | 1940 | 1941 | 1940 | 1941 |
| January | 46.707 | 50.154 | 240.716 | 256.648 |
| February | 45.851 | 51.293 | 242.833 | 264.975 |
| March | 47.079 | 52.067 | 251.711 | 270.131 |
| April | 46.815 | 51.981 | 252.080 | 269.775 |
| May | 51.570 | 52.166 | 264.098 | 267.534 |
| June | 54.618 | 52.685 | 273.438 | 262.750 |
| July | 51.591 | 53.481 | 265.502 | 258.272 |
| August | 51.176 | ..... | 262.455 | ..... |
| September | 50.348 | ..... | 251.024 | ..... |
| October | 51.490 | ..... | 257.946 | ..... |
| November | 50.577 | ..... | 258.214 | ..... |
| December | 50.101 | ..... | 256.988 | ..... |
| Year | 49.827 | ..... | 256.425 | ..... |

New York quotations, cents per pound. London, pounds sterling per long ton.

## ZINC

| | St. Louis | | |
|---|---|---|---|
| | 1939 | 1940 | 1941 |
| January | 4.500 | 5.644 | 7.250 |
| February | 4.500 | 5.534 | 7.250 |
| March | 4.500 | 5.750 | 7.250 |
| April | 4.500 | 5.750 | 7.250 |
| May | 4.500 | 5.803 | 7.250 |
| June | 4.500 | 6.235 | 7.250 |
| July | 4.516 | 6.250 | 7.250 |
| August | 4.719 | 6.389 | ..... |
| September | 6.104 | 6.920 | ..... |
| October | 6.500 | 7.250 | ..... |
| November | 6.500 | 7.250 | ..... |
| December | 5.980 | 7.250 | ..... |
| Year | 5.110 | 6.335 | ..... |

St. Louis quotations, Prime Western, cents per pound.

## CADMIUM AND ALUMINUM

| | Cadmium | | Aluminum | |
|---|---|---|---|---|
| | 1940 (a) | 1941 (a) | 1940 | 1941 |
| January | 79.038 | 80.000 | 20.000 | 17.000 |
| February | 80.000 | 82.273 | 20.000 | 17.000 |
| March | 80.000 | 89.038 | 19.769 | 17.000 |
| April | 80.000 | 90.000 | 19.000 | 17.000 |
| May | 80.000 | 90.000 | 19.000 | 17.000 |
| June | 80.000 | 90.000 | 19.000 | 17.000 |
| July | 80.000 | 90.000 | 19.000 | 17.000 |
| August | 80.000 | ..... | 18.000 | ..... |
| September | 80.000 | ..... | 18.000 | ..... |
| October | 80.000 | ..... | 18.000 | ..... |
| November | 80.000 | ..... | 17.522 | ..... |
| December | 80.000 | ..... | 17.000 | ..... |
| Year | 79.920 | ..... | 18.691 | ..... |

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

## ANTIMONY, QUICKSILVER, AND PLATINUM

| | Antimony (a) New York | | Quicksilver (b) New York | | Platinum (c) New York | |
|---|---|---|---|---|---|---|
| | 1940 | 1941 | 1940 | 1941 | 1940 | 1941 |
| January | 14.000 | 14.000 | 156.962 | 165.846 | 40.000 | 36.000 |
| February | 14.000 | 14.000 | 178.000 | 170.182 | 40.000 | 36.000 |
| March | 14.000 | 14.000 | 180.921 | 177.692 | 40.000 | 36.000 |
| April | 14.000 | 14.000 | 173.538 | 180.077 | 38.923 | 36.000 |
| May | 14.000 | 14.000 | 181.538 | 180.000 | 38.000 | 36.000 |
| June | 14.000 | 14.000 | 197.360 | 183.920 | 38.000 | 36.000 |
| July | 14.000 | 14.000 | 194.423 | 188.577 | 38.000 | 36.000 |
| August | 14.000 | ..... | 184.111 | ..... | 38.000 | ..... |
| September | 14.000 | ..... | 173.333 | ..... | 36.167 | ..... |
| October | 14.000 | ..... | 168.846 | ..... | 36.000 | ..... |
| November | 14.000 | ..... | 168.391 | ..... | 36.000 | ..... |
| December | 14.000 | ..... | 164.960 | ..... | 36.000 | ..... |
| Year | 14.000 | ..... | 176.865 | ..... | 37.924 | ..... |

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk f.o.b. Laredo, Tex., 13,000 for July. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, per ounce troy.

## PIG IRON

| | Bessemer | | Basic | | No. 2 Foundry | |
|---|---|---|---|---|---|---|
| | 1940 | 1941 | 1940 | 1941 | 1940 | 1941 |
| January | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| February | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| March | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| April | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| May | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| June | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| July | 23.50 | 24.50 | 22.50 | 23.50 | 23.00 | 24.00 |
| August | 23.50 | ..... | 22.50 | ..... | 23.00 | ..... |
| September | 23.50 | ..... | 22.50 | ..... | 23.00 | ..... |
| October | 23.50 | ..... | 22.50 | ..... | 23.00 | ..... |
| November | 23.50 | ..... | 22.50 | ..... | 23.00 | ..... |
| December | 23.50 | ..... | 22.50 | ..... | 23.00 | ..... |
| Year | 23.500 | ..... | 22.500 | ..... | 23.000 | ..... |

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces

# PERSONAL ITEMS

**E. R. Shepherd,** formerly in charge of B. R. X., is now in charge of the field operations of B. C. Magnesium Co., Ltd.

**F. W. Marshall** has been made manager of the Big River Gold Mine property, in New Zealand.

**C. H. Donaldson** has been appointed manager of Kelsey Creek Gold Mining Co., Ltd., operating in Queensland.

**Glen Farnham** has become mill superintendent at the property of Pride of the West company at Howardsville, Colo. He succeeds **Arthur L. Saunders** deceased.

**J. A. Gladman** has been made mill superintendent for the Nchanga Consolidated Copper Mines, Ltd., in Northern Rhodesia.

**L. E. Putnam,** mining engineer, has been appointed manager of the Riverside mine, in Alaska, operated by J. H. Scott Co., of San Francisco, Calif.

**Major Angus W. Davis,** of Nelson, B. C., is in charge of the development of the Red Rose property for the C. M. & S. Co.

**Victor Dolmage,** prominent British Columbia consulting geologist, is in the Kirkland Lake district on professional work.

**José B. Zozaya** has gone from Mullan, Idaho, to Charcas, S.L.P., Mexico, where he is on the engineering staff of Mina Tiro General.

**John Kelly,** of Hobbs, N. M., has become States Geologist of New Mexico by appointment of Governor Miles of that State.

**Reina Ranta,** assistant geologist, London Mining & Milling Company, Alta, Colo., has received a fellowship in geology at Yale University, where he will attend this fall.

**Elwood Stockman,** formerly mill engineer with Chile Exploration Co., at Chuquicamata, Chile, is now with the United States Smelting Co., at Newhouse Building, Salt Lake City, Utah.

**W. T. Cavers,** at one time assistant superintendent of the Granby smelter, at Anyox, was a recent visitor in Vancouver and Anyox. Mr. Cavers is now with Falconbridge.

**G. H. Newport,** formerly mine superintendent for Benguet Consolidated, in the Philippines, has gone to Borneo, Dutch East Indies, as manager of Toeajan Coal Concessions at Samarinda.

**L. S. Taylor,** metallurgist for North Camarines Gold Mining Co., in the Philippine Islands, has returned to the United States and can be reached at Pueblo, Colo.

**O. Cutler Shepard,** who spent the last academic year as visiting associate professor of metallurgy at Massachusetts Institute of Technology, has resumed his work as associate professor of mining and metallurgy at Stanford University.

**J. R. Welch,** who recently returned from South America, where he was with the Chile Exploration Co. at Chuquicamata, Chile, is now associated with Freeport Sulphur Co. at Freeport, Tex.

**H. Foster Bain,** adviser on mines to the Philippine Government, who has

H. FOSTER BAIN

been in Washington for temporary service on defense work, is returning to Manila on the clipper of Sept. 9.

**S. S. Baarnof,** mining engineer of Seattle, recently left for Seward, Alaska, to survey the Seldovia Red Mountain chrome deposit and to lay out a tramway and a wharf.

**F. B. Shay,** mining engineer of the Foote Mineral Co., recently left Philadelphia, for Cuba to investigate manganese, chrome, and other mineral deposits.

**Donald Birkner** has been appointed mine foreman of the Draper mine, at Marble Hill, Minn., on the Mesabi. The Draper is operated by the Evergreen Mines Co.

**John W. Prout, Jr.,** consulting mining engineer and geologist, has moved his office from Los Angeles to the California Bank Building, 9441 Wilshire Boulevard, Beverly Hills, Calif.

**Patrick Green,** for some years mining engineer for the Northwest Magnesite Co. at Chewelah, Wash., will be in charge of chrome mining in Cuba for the Harbison-Walker Refractories Co.

**Charles Towne,** long head of the department of information conducted by the Anaconda Copper Mining Co., at Butte, Mont., retired from that post on June 1 last.

**Frank H. Gunnell,** a consulting geologist of Salt Lake City, has been made president and general manager of Western Gold & Exploration Co., which is operating mines at Valley Creek, Stanley, Idaho.

**James Hopkins** has resigned his position as chief mining engineer with Luzon Stevedoring Co., largest producers of manganese in the Philippines, and has returned to the United States. His present address is 2367 Hilgard Ave., Berkeley, Calif.

**Harry M. J. Lee,** Chinese mining engineer and graduate of the New Mexico School of Mines, is directing extended test work on a 7,000-acre tract of the Sawtooth Placer Syndicate in the Sawtooth district, southern Humboldt County, Nev.

**William Fink,** mining engineer of El Paso, Tex., and **F. G. Bacon,** metallurgist of Chihuahua, Mexico, have gone to Bolivia with **H. C. Dudley,** president of Delores Mines Corp. They are examining gold and tungsten properties.

**Dr. Frank S. Hudson** resigned recently as president of the Pacific Coast Section of the American Association of Petroleum Geologists, Los Angeles, to join the staff of Yuba Consolidated Gold Fields as efficiency engineer, with offices at 351 California St., San Francisco, Calif.

**Eugene Poncelet** has been appointed Special Belgian Advance Fellow of the Belgian-American Educational Foundation, Inc., in association with **Prof. A. M. Gaudin,** of the Massachusetts Institute of Technology, to develop a new theory of crushing and grinding.

**State Senator C. W. Spence** of Utah has been appointed Metal Mine Inspector for that State, succeeding **E. H. Hodges.** Mr. Spence has served in the legislatures of both Wyoming and Utah and has worked in both coal and metal mines, having been at one time foreman for Utah Apex.

**Major Wendell W. Fertig,** general superintendent of Samar Mining Co., has been called to active military duty. Major Fertig is stationed in the office of the Department Engineer, Headquarters Philippine Department, Fort Santiago, Manila, P. I.

**Robert W. Handley** expects to arrive in New York City in September. In the capacity of consulting engineer for Union Minière du Haut-Katanga, with which company he has been associated for the last 15 years, he is establishing his residence in Denver, Colo.

**Richard Steiber,** assistant professor of geology at Dartmouth College, is spending his vacation in the Tri-State district making a study of mineral deposition which occurred in the Picher section of the mining field. He is making an effort to ascertain the direction of flow of the mineralized waters, or solutions, which carried and deposited zinc, lead, and other minerals found in the various ore beds.

**N. K. Karchmer,** manager, in charge of operation and production, of the mine and plant of Kyanite Products Corp., Farmville, Va., was formerly in Russia as technical expert on the construction and initial operation of the Soviet Union's apatite plant in the Kola Peninsula. After returning to the United States he was engaged by the Phosphate

Recovery Corp. and was in charge of its flotation plants in Tennessee for five years.

**Sherwin F. Kelly,** president of Sherwin F. Kelly Geophysical Services, Inc., has recently returned to New York City from professional work in Idaho. He is now leaving for the southwestern states to supervise a seismic survey being carried out by his organization, and expects to visit El Paso and Albuquerque before returning to the East.

**F. Whalley Watson,** consulting engineer and secretary of Oregon Mining Association, has accepted a United States Maritime Commission appointment and has been assigned to the staff of the Field Inspection Office at Oregon Shipbuilding Corporation's shipyard at Portland, Oregon, which is building 10,000-ton cargo ships under Commission supervision. During the World War, Mr. Watson was production manager at the Columbia River Shipbuilding Corp. shipyard at Portland.

**Samuel R. Coghlan,** for the past several years assistant smelter superintendent of the Braden Copper Co. in Chile, accepted an appointment as metallurgical engineer with the U. S. Bureau of Mines early this year, with headquarters in Salt Lake City. He is now engineer in charge of the hydrometallurgical and electrolytic managenese pilot plants which the Bureau is operating in Boulder City, Nev.

**Victor J. Pimentel** and **R. W. Prince,** both graduates of the Mackay School of Mines, a department of the University of Nevada, have been assigned to investigate and appraise mining claims and properties lying within the 50x100-mile Tonopah bombing range of the U. S. Army in southern Nye County, Nev., wherein aerial bombing practice may preclude work on a few projects.

**Paul Linz,** for many years associated with American Metal Co. both in the United States and abroad as manager of the company's London and Berlin offices, has been appointed a commodity specialist in the price division of the Office of Price Administration and Civilian Supply. Until his appointment Mr. Linz was a partner in the firm of Carl M. Loeb, Rhoades & Co., from which he has resigned to assume his new duties at OPACS, where he will devote his attention principally to lead.

**Clyde H. Wilson,** formerly president of International Geophysics, Inc., of Los Angeles, has been working in the Tri-State district as geophysicist in connection with the geophysical exploration project now being carried on by the Kansas geological survey and the University of Kansas engineering experiment station in co-operation with the Tri-State Zinc and Lead Ore Producers Association. **Dr. R. M. Dreyer,** economic geologist of the State Geological Survey, is in charge of the field party of five men now completing their studies over a two-month period. **Dean J. J. Jokosky,** University of Kansas engineering school, and **Dr. R. C. Moore,** director of the State Geological Survey, are supervising the project, which, it is hoped, will develop geophysical techniques which can be used in ore exploration.

J. M. BOWLBY

**J. M. Bowlby** has been elected president of the Eagle-Picher Lead Co., succeeding **Joseph Hummel, Jr.,** who had asked to be relieved of his duties after serving the company for 50 years. Mr. Hummel has been elected chairman of the board. Mr. Bowlby will assume his new position on Sept. 1.

# OBITUARY

**January Jones,** for nearly 40 years a well-known figure in Nevada mining and mine promotion, died recently at Reno.

**Evald Anderson,** technical director of the Western Precipitation Corp., of Los Angeles, died on July 19. He was 58.

**Dr. Robert Thomas Hill,** geologist, scientist, writer, and Texas pioneer, died in Dallas, Tex., on July 28.

**Fred Lindbeck,** mining engineer, prominent in Utah mining and civic activities, died on July 25 at the age of 48.

**George Henry Blakemore,** prominent in New South Wales as a metallurgist, executive, and consultant, died recently at Sydney, Australia, at the age of 72.

**The Right Hon. Sir Robert Horne,** chairman of the board of The Zinc Corporation, of London, for 14 years, died recently in England.

**Prof. N. S. Kurnakov,** distinguished Russian scientist and director of the Russian Institute of General and Inorganic Chemistry of the Academy of Sciences of the U.S.S.R., died on March 10 last at the age of 80.

**E. Knechtges** was almost instantly killed in an auto accident near Iron Mountain, Mich., on June 7 last. He had been employed by the Inland Steel Co. and was working at the Sherwood Mines, in Iron River, Mich., at the time of his death.

**Clarence Estes Wheelock** general superintendent of the American Metal Co. of Texas Presidio mine at Shafter, Tex., died in El Paso, Tex., on July 14 at the age of 49. Mr. Wheelock was born in a mining camp, and followed that work through his life. For fourteen years he was with the American Metal Company of Texas, and of that number, spent all but the three during which the mines were closed, at Shafter. For two and one-half years he had been general superintendent there. During the years the mines were closed in Shafter, he was with the same company in Terrero, N. M. His entire mining career was spent in the Southwest, with the exception of two years he was in Argentina, S. A. During the World War he was in the United States Navy, and received his training at San Diego and in the United States Proving Ground in Maryland. On Aug. 29, 1921 Mr. Wheelock was married to Miss Stacia Pardee, of Hagerman, N. M. Mrs. Wheelock survives him.

**Floyd William Parsons,** mining engineer, editor, and author, who was associate editor of *Engineering and Mining Journal* from 1907 to 1910 and who later was editor of *Coal Age,* died in New York on Aug. 7 at the age of 61. At the time of his death Mr. Parsons was editorial director, vice president, and a director of Robbins Publishing Co., with which he had been associated for 21 years. He was an alumnus of Lehigh University and a member of the A.I.M.E. and many other scientific and technical associations.

**Herman Carl Bellinger,** former vice president of Chile Copper Co. and Chile Exploration Co. and president of Chile Steamship Company, died at Spokane, Wash., on July 27. He was born in Caub, Germany, on April 23, 1867, and was brought to the United States at an early age. After being educated by his father, a graduate in mining engineering of Freiberg, he started his mining and metallurgical career as a chemist in 1886. During the next 23 years he served in many capacities, from chemist to general manager, with various copper and lead mining companies in the United States.

From 1909 until 1914 Mr. Bellinger was general manager of the Great Cobar, Ltd., in Australia, and during 1912 he served as president of the Australasian Institute of Mining and Metallurgy. He joined the consulting staff of Guggenheim Brothers in New York in 1914, and in 1916 was appointed general manager of the Chile Exploration Co. at Chuquicamata, Chile, this company being the operating subsidiary of Chile Copper Co., then controlled by Guggenheim Brothers. In 1920 he was recalled to New York to become vice president in charge of operations of the same company. In 1923, upon the acquisition of control of the Chile Copper Co. by the Anaconda Copper Mining Co., Mr. Bellinger was retained in his position with the Chile Exploration Co. and in addition was made vice president of Chile Copper Co., and later that same year became president of the Chile Steamship Co. He held these various positions with distinction until his retirement from active service on Dec. 31, 1940. In 1935 Mr. Bellinger was awarded the Order of Merit, grade of Knight Commander, by the President of Chile in recognition of his accomplishments in the betterment of the economic welfare of the people of Chile. Mr. Bellinger was a member of the American Institute of Mining and Metallurgical Engineers, on the honor roll and a member of the Mining and Metallurgical Society of America. He is survived by his widow, Mrs. Bertha May Bellinger; his daughter, Mrs. Frank N. May, of Santiago, Chile; and his son, Carl Atherton Bellinger, who is associated with the Republic Aviation Corporation.

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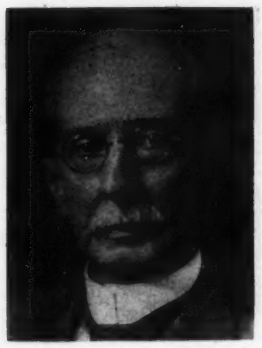
# NEW BOOKS



PROF. ROBERT PEELE

MINING ENGINEERS' HANDBOOK. *Third Edition, in two volumes. Robert Peele, editor-in-chief. John Wiley & Sons, Inc., New York. Pages 2442. Price $15.*

UNDOUBTEDLY many a mining engineer has regarded Peele's monumental Handbook as worth its weight in gold. The universal high esteem won by the first and second editions of this encyclopediac work will surely be enjoyed by the third edition also. In outward appearance the Handbook has changed considerably, the two volumes now being 5½x8⅜ in. in size, as compared with the approximately 4x7-in. dimensions of their predecessors. With this change they become uniform members (Nos. VI and VII) of the publishers' new Engineering Handbook Series, and, at the expense of a slight decrease in portability, are easier to use as books of reference.

In addition to a new format, involving a complete resetting of the type, the third edition has been revised to bring it as close to date as possible. Seventeen of the 45 sections, moreover, have undergone radical revision of text and illustrations, and a new section, on geophysics, has been added. The 17 sections are those dealing respectively with earth excavation, explosives, rock excavation, shaft sinking in unstable and waterbearing ground; also Sec. 10, of 640 pages, on prospecting, development and exploitation of mineral deposits; Sec. 12, on hoisting plant, shaft pockets, and ore bins; 14, on mine ventilation; 15, compressed air practice; 16, electric power for mine service; 22, wages and welfare; 24, mining laws; 26, aërial tramways and cableways; 27, underground mechanical loading, conveying, and handling; 32, selling, purchasing, and treatment of ores; 33, gold amalgamation and cyanidation; 35, preparation and coking of bituminous coal; and Sec. 40, on power and power machinery.

Peele's Handbook is now 23 years old. The second edition appeared in 1929. During the 12 years that have since elapsed further changes have become necessary, because of deaths or inability to serve again, in the list of more than 50 associates who have aided in preparing the various sections in the past. To this list are now added ten new names including C. L. Bogert, S. R. Russell, C. F. Jackson, R. H. Chambers, P. B. Bucky, G. E. McElroy, A. W. Loomis, W. M. Dake, J. B. Morrow and staff, and Theodore Baumeister, Jr. In addition to being the associate editor of one of the sections, moreover, John A. Church has collaborated extensively with the editor-in-chief, as credited to him on the title page.

OPEN-CUT METAL MINING. *By E. D. Gardner and McHenry Mosier. Bulletin 433. United States Bureau of Mines. Pp. 176, paper cover. Sold by Superintendent of Documents, Washington, D. C., at 40c.*

WITH Bulletin 433 ends a series of eight papers on mining methods in metal mines in the United States, publication of which was begun by the Bureau of Mines in 1929. This final pamphlet, after discussing factors that affect the selection of an open-cut method, takes up the subject of equipment for drilling, excavating, and transporting. It then describes actual operations in various districts beginning with the ranges of the Lake Superior Iron Country, one by one; next passing to the open-cut copper mines of the Western States. Various miscellaneous operations in this category are then discussed, such as that of the Yellow Aster, the Mountain Copper, and other projects conducted for gold; the Oronogo zinc mine, in Missouri; and the Sulphur Bank and Cloverdale quicksilver mines, in California. The bulletin is comprehensive, informative, and well illustrated. Considerable interesting material in the form of tabular data is included.

DANA'S MANUAL OF MINERALOGY. *Fifteenth edition. Revised by Cornelius S. Hurlbut. John Wiley & Sons, Inc., New York. Pp. 480. Price $4.*

THIS NEW EDITION, which appears 13 years after the issuing of its predecessor, is a very different book in text, illustrations, and arrangements from the earlier one. The edition of 1928 was a revision by the late Prof. William E. Ford, whose death two years ago prevented him from again bringing the Manual up to date, as he is said to have intended. Both editions are divided into five major divisions—namely, Crystallography, Physical Mineralogy, Chemical Mineralogy, Descriptive Mineralogy, and Determinative Mineralogy; but here the similarity tends to disappear. In the new book the rewriting and the rearrangement have been extensive, although in many a paragraph one can perceive that the older text has been followed to a varying extent. Some changes have been made in the classification of the minerals and likewise the determinative tables are differently arranged. An interesting addition is a separate mineral index at the end, in which not only the page number of the reference to each mineral is given but also the composition formula, crystallization, specific gravity, and hardness, together with "remarks," such data being found elsewhere in the book in their normal place, or places, as well. Finally the format, size, and binding have been changed completely. The new volume is a superior book.

FIELD GEOLOGY, FOURTH EDITION. *By Frederic H. Lahee, McGraw-Hill Book Co., 330 West 42d St., New York. Pp. 853. Price $5.*

IN PREPARING this new edition Dr. Lahee has made some rearrangement, though not extensively. Parts have been rewritten and some additions have been made. In selecting new topics for treatment, he says he has taken only those that are definitely applicable in the study of pure geology and has avoided discussion of methods that are of limited application therein. He has added new material on mass movements, varves, lensing strata, permeability of sedimentary rocks, flow structure and fracture structure in igneous rocks, and other matters. Those familiar with the previous editions will be glad to have the new volume.

INTRODUCTION TO GEOLOGY. SECOND EDITION. *By E. B. Branson and (the late) W. A. Tarr. McGraw-Hill Book Co., 330 W. 42d St., New York. Pp. 482. Price $3.75.*

AS WITH the earlier edition, issued in 1935, this volume is intended for the elementary student, and the work of revision has been directed principally toward further simplification to facilitate understanding. Principles are emphasized and technicalities suppressed. Presentation of illustrations has been bettered by improving the paper.

RESEARCH—A NATIONAL RESOURCE. *II—Industrial Research. Report of National Research Council to National Resources Planning Board. Dated December, 1940. Pp. 370. For sale by Superintendent of Documents, Washington, D. C. Price $1.*

DECLARING that the United States has become the acknowledged leader in industrial research and that the country is now independent of foreign sources in respect to adequate laboratory apparatus and facilities, the Council's report presents a fund of information on this activity. Discussing first the position achieved for research in the national economy both as a resource to small companies and as a growth factor in industry, the

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report also gives three examples of research—in aëronautics, the petroleum industry, and the iron and steel industry respectively. Facts are then given as to the location and extent of research activity. For example, 2,350 companies are shown to have over 70,000 persons engaged in technical research in 2,200 laboratories, the total cost being $4,000 per man-year. Ratio of research expenditures to sales is 0.6 percent and to net income 6 percent. Perhaps the most interesting section of the report is presented under the head of "Men in Research," successive parts dealing with the respective rôles of the chemist, physicist, biologist, mathematician, and engineers in the various branches of that profession.

ELEMENTS OF MINING. *By Robert S. Lewis. John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., London. Pp. 579. Illustrated. Price $5.50.*

IN HIS PREFACE to this second edition of this book, the author explains that he has revised the work to take note of changes and developments that have occurred since the first edition was published in 1932. For example, deep mining is raising problems in ground support, air conditioning, and hoisting. Health and safety are receiving more attention, particularly in the prevention of fine dust that causes silicosis. Detachable bits are superseding conventional sharpened steel, and the mechanical loader is displacing the hand shovel in some mining operations. Discussion of these and other modern aspects of mining amplify the text of the first edition and bring it up to date.

WAGE AND HOUR MANUAL, 1941 EDITION. *Published by Bureau of National Affairs, Incorporated, 2201 M St., N.W., Washington, D. C. Pp. 1120. Price $5.*

THE PUBLISHERS CLAIM that this volume embraces, so far as can be discovered, all documentary material on Government regulation of wages and hours—the laws, administrative regulations and interpretations, and court decisions. Supplementing the basic material are 300 answers to questions on the law's application to specific cases, charts illustrating the scope of various exemptions, sample payroll forms, and other devices. The volume is in three parts: (I), 17 chapters which treat separately the overtime, minimum wage, and other provisions of the Fair Labor Standards Act. (II), Similar attention is given the Walsh-Healey Public Contracts Act and miscellaneous Federal laws regulating wages and hours. (III), State legislation is treated more briefly, with digests of wage, hour, child labor, and industrial homework regulations for each State.

AIR AND GAS COMPRESSION. *By Thomas T. Gill. John Wiley & Sons, Inc., New York. Pp. 181. Price $3.*

THIS IS A TEXTBOOK on the theory of compression, wherein the author has endeavored to utilize some of the results of recent research conducted in the properties of gases. After consideration of gas laws and other fundamentals, the treatment of the subject proceeds under the subdivisions of energy relations and single-stage, compression, compressor capacity, volumetric efficiency and clearance, indicated horsepower, two-stage and multi-stage compression, exponent of compression volumetric efficiency and compressor brake horsepower, supercompressibility, equipment, and plant design. A chapter is added on flow of gas in pipe lines. A feature of the book is the large number of alignment charts and the tabular data in the appendix.

ANALYTICAL CHEMISTRY OF INDUSTRIAL POISONS, HAZARDS AND SOLVENTS. *By M. B. Jacobs. Interscience Publishers, Inc., 215 Fourth Ave., New York. Pp. 661. Price $7.*

CHEMICAL ASPECTS of industrial hygiene provide the subject of this book. The volume should interest those concerned with hygiene in a wide range of industries as well as all individuals who have to do with occupational diseases and other risks arising from industrial use or production of toxic materials. Most of the book is devoted to consideration of methods and equipment used in the chemical analysis for each of these materials. The latter comprise silica, lead, mercury, arsenic, and a dozen additional harmful metals; radioactive substances; compounds of sulphur, of phosphorus, of nitrogen, and of the halogens; also CO, $CO_2$, HCN, and CN; and eight other groups of chemical compounds including chemical warfare agents. Beforehand, the author discusses methods of sampling and the equipment required; measurement of gas volume and quantity; absorbers and absorbents; and the chemical and microscopic estimation of dust. Much specialized information has been brought painstakingly within the covers of the book.

DIRECTORY OF NEVADA MINES. *The Mining Press, Reno, Nev. Pp. 45. Price $1.*

A WELCOME COMPILATION, in the preparation of which the author has taken special pains to be accurate. The subject is treated by counties, giving a map of the mining districts and an alphabetical list of mining companies in each county. The latter are designated as active, developing or idle, and information is given regarding the kind of ore produced. Anyone interested in Nevada mines will find the pamphlet invaluable.

# PUBLICATIONS

## RECEIVED

*"Copper Deposits of Newfoundland."* Bulletin 20, Geological Survey of Newfoundland, St. John's. Pp. 175, Plus 30 unbound maps (geological and geophysical) and sections.

*"Limestone and Lime."* By George I. Whitlatch, Markets Circular No. 10, Tennessee Division of Geology, Nashville, Tenn. Pp. 38. Price 10c.

*Employment and Earnings in the Engineering Profession, 1929 to 1934.* Bulletin 682, U. S. Department of Labor, Bureau of Labor Statistics. For sale by Superintendent of Documents, Washington, D. C. Pp. 234. Price 25c.

*"Tippan County (Mississippi) Mineral Resources."* Bulletin 42, Mississippi State Geological Survey, University (P.O.), Miss. Pp. 228. A report based on work done in 1938 covering prospecting of clays and other minerals and geologic studies and mapping.

*"A Review of the Broken Hill Lead-Silver-Zinc Industry."* Presidential address, 1940, of O. H. Woodward, president of Australasian Institute of Mining and Metallurgy. *Proceedings*, Austr. I.M.M., No. 119, Part 1. Pp. 223.

*"Lessons in Arc Welding,"* second edition. Published by Lincoln Electric Co., Cleveland, Ohio. Pp. 176. Price 50c. postpaid in United States, 75c. elsewhere. A series of 60 lessons which forms the basis of instruction in the Lincoln Arc Welding School. Fundamental facts of welding are presented.

**U. S. Geological Survey has issued the following (for sale by Superintendent of Documents, Washington, D. C., at stated price):**

"Quicksilver Deposits of Mayacmas and Sulpher Bank Districts, California." Bulletin 922-L. Price 45c.

"Chromite Deposits of Eastern Part of Stillwater Complex, Stillwater County, Mont." Bulletin 922-N. Price 40c.

"Tungsten Deposits in Tungsten Hills, Inyo County, Calif. Bulletin 922-Q. Price 20c.

"Quicksilver Deposits in San Luis Obispo County and Southwestern Monterrey County, California." Bulletin 922-R. Price 75c.

"Tungsten Deposits of Benton Range, Mono County, California." Bulletin 922-S. Price 30c.

"Structural Control of Ore Deposition in Uncompaghre District, Ouray County, Colo." Bulletin 906-E. Price 20c.

"Phosphate Investigation in Florida, 1934 and 1935." Bulletin 906-F. Price 30c.

"Geology of Upper Tetling River District, Alaska." Bulletin 917-B. Price 50c.

"Goodnews Platinum Deposits, Alaska." Bulletin 918. Price 50c.

"Geology and Mineral Resources of Randolph Quadrangle, Utah, Wyoming." Bulletin 923. Price 55c.

"Fineness of Gold from Alaska Placers." Bulletin-C. Price 30c.

"Manganese Carbonate in the Batesville District, Arkansas." Bulletin 921-A. Price 60c.

"Geology and Mineral Resources of Randolph Quadrangle, Utah-Wyoming." Bulletin 923. Price 55c.

"The Mineral Industry of Alaska in 1939." Bulletin 926-A. Price 20c.

"Tungsten Resources of Blue Wing District, Lemhi County, Idaho." Bulletin 931-A. Price 30c.

"Some Quicksilver Prospects in Adjacent Parts of Nevada, California and Oregon. Bulletin 931-B. Price 25c.

**Bureau of Mines, Washington, D. C., has issued the following (no charge is made):**

"Nonmetallic Minerals Needed for National Defense—1. Fertilizer Materials." I. C. 7159. Also, "3. Nitrates." I. C. 7170.

"Comparison of Manganese Steel With Carbon Steel for Detachable-Bit Drill Rods." R. I. 3566.

"Pulmonary Diseases in the Mining Industry." I. C. 7146.

"Problem of Accident Prevention at Small Mines." I. C. 7147.

"Froth Flotation and Agglomerate Tabling of Micas." R. I. 3558.

"Alunite Resources of the United States." R. I. 3561.

**Dominion Geological Survey, Ottawa, Canada, has issued the following, at the price stated in each case:**

"MacKay Lake Area, Northwest Territories." Preliminary report and separate map. Paper 41-1. Price 10c.

"Great Slave Lake to Great Bear Lake, Northwest Territories." Preliminary map. Price 10c.

"Ingray Lake Map-Area, Northwest Territories." Preliminary report. Price 10c.

# What Metal Statistics Show

PRODUCERS and government officials met in Washington on July 17 to discuss greater output of copper. It was announced that some increase in the present rate of domestic copper production is possible but further discussions are necessary to determine the methods most feasible to follow to bring out additional tonnages as fast as possible. It was thought that by granting producers a subsidy over the 12c., price, the industry believes that 150,000 to 200,000 tons of additional production would be forthcoming over the next two years. Washington, however, has made no announcement to pay any producer a subsidy over the 12c. basis.

On Aug. 6 copper was placed under additional priority control. The new order requires that after Aug. 6 no delivery of refined copper can be made except upon specific direction of the Priorities Director.

Copper producers attached little of significance to a decline in shipments to domestic consumers during June. A temporary shrinkage in arrivals of copper from Latin American countries was responsible for part of the decline from the record total of 144,293 tons distributed in May to 115,139 moved during June. Imports during July will be larger, according to trade authorities.

Stocks of duty-free refined metal at the end of June amounted to 98,164 tons, an increase of 5,088 tons for the month. On the other hand, stocks of blister declined 5,886 tons.

During the first six months of 1941 the deliveries came to 749,977 tons, of which 154,916 tons consisted of copper of foreign origin distributed through the Metals Reserve Company. Since Jan. 1, 1941, stocks of duty-free copper in this country were reduced 44,608 tons.

A summary of the domestic figures for May and June, in tons, follows:

| Production: | May | June |
|---|---|---|
| Crude | (a) 90,342 | 82,674 |
| Refined | 89,390 | 88,560 |
| Deliveries, refined (b): | | |
| Domestic customers | (a) 144,293 | 115,097 |
| Export | ..... | 42 |
| Totals | (a) 144,293 | 115,139 |
| Stock at end, refined (c) | (a) 93,076 | 98,164 |

(a) Corrected. (b) Includes delivery of duty-paid copper for domestic consumption (Metals Reserve Company acquisitions). (c) At refineries, on consignment and in Exchange warehouses. Does not include copper at consumers' plants or warehouses.

▶ZINC—The zinc statistics for June and July, all grades, in tons, according to the American Zinc Institute:

| | June | July |
|---|---|---|
| Stock at beginning | (b) 8,327 | 7,404 |
| Production | 62,236 | 66,419 |
| Production, daily rate | 2,075 | 2,143 |
| Shipments (a) | 63,159 | 64,086 |
| Exports | 1,254 | 730 |
| Unfilled orders | 92,583 | 81,456 |
| Stock at end | 7,404 | 9,737 |

(a) Total shipments, including exports. (b) Corrected.

Operations of the Prime Western division showed production of 28,793 tons during July, with shipments of 27,927 tons and stocks at the end of the month of 5,160 tons.

E. R. Stettinius jr., Director of Priorities, announced on July 30 that producers of metallic zinc will set aside an amount equal to 27 percent of June production for the emergency pool for August. This amount approximates 19,000 tons. The pool for July was 22 per cent of May production.

▶LEAD—Statistics covering lead refined in this country for the months of May and June, in tons, according to the American Bureau of Metal Statistics, follow:

| | May | June |
|---|---|---|
| Stock at beginning | 42,899 | 34,018 |
| Production: | | |
| From domestic ore | 46,104 | 38,669 |
| Secondary and foreign | 14,405 | 9,555 |
| Totals | 60,509 | 48,224 |
| Domestic shipments | 69,382 | 57,969 |
| Stock at end | 34,018 | 24,265 |

Arrangements to buy up to 225,000 tons of Mexican and Canadian lead have been completed. Of this quantity 50,350 tons represents metal now held in stockpiles and available for release shortly. Negotiations for the purchase of Peruvian lead have not yet been concluded.

▶TUNGSTEN—Stimulated by defense activities, production of tungsten ore and concentrate in the United States in 1940 increased 42 percent over that of 1939, according to the Bureau of Mines. Shipments from domestic mines, which were 24 percent more than in 1939, were not only the largest since 1917 but have been exceeded in only one other year—1916.

Production of tungsten concentrate (reduced to an equivalent of 60 percent $WO_3$) was 5,120 short tons in 1940, compared with 3,603 tons in 1939.

In 1940, 5,319 tons of concentrated ore (reduced to an equivalent of 60 percent $WO_3$) were shipped from domestic mines, compared with 4,287 tons in 1939. The reported average value per unit f.o.b. mines of the tungsten concentrate shipped increased to $20.61 in 1940, from $17.11 in 1939. Shipments of tungsten concentrate were made from Arizona, California, Colorado, Idaho, Missouri, Montana, Nevada, New Mexico, Utah, and Washington in 1940. California replaced Nevada as the largest tungsten producer.

Imports of tungsten ore and concentrate for domestic consumption during 1940 amounted to 5,414 tons, containing 2,805 tons of tungsten. This compares with 1,371 tons, containing 742 tons of tungsten, in 1939.

## E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

| | | | |
|---|---|---|---|
| 1929 | 110.33 | 1935 | 74.66 |
| 1930 | 82.87 | 1936 | 73.45 |
| 1931 | 60.20 | 1937 | 90.86 |
| 1932 | 48.26 | 1938 | 73.67 |
| 1933 | 59.79 | 1939 | 77.71 |
| 1934 | 69.59 | 1940 | 79.22 |

| | 1939 | 1940 | 1941 |
|---|---|---|---|
| January | 77.12 | 80.85 | 82.48 |
| February | 76.89 | 77.23 | 82.76 |
| March | 77.00 | 77.94 | 83.27 |
| April | 74.79 | 77.19 | 83.48 |
| May | 73.61 | 77.68 | 83.48 |
| June | 73.17 | 78.85 | 83.51 |
| July | 71.95 | 76.72 | 83.60 |
| August | 73.88 | 76.71 | .... |
| September | 83.07 | 79.40 | .... |
| October | 84.25 | 82.49 | .... |
| November | 83.80 | 83.14 | .... |
| December | 82.89 | 82.42 | .... |

## United States Lead Imports

Latest statistics covering importations of lead into the United States in tons, follow:

| | May 1940 | May 1941 | Jan.-May 1940 | Jan.-May 1941 |
|---|---|---|---|---|
| Ore and matte (content) | 5,172 | 4,840 | 31,435 | 23,363 |
| Canada | 391 | 533 | 1,513 | 1,885 |
| Newfoundland | ..... | ..... | ..... | 452 |
| Mexico | 99 | 113 | 643 | 571 |
| Argentina | ..... | ..... | 4,035 | 7,135 |
| Bolivia | ..... | 519 | 1,817 | 2,354 |
| Chile | 1,555 | 1 | 2,681 | 1,299 |
| Peru | 130 | 1,196 | 8,612 | 2,910 |
| Great Britain | ..... | ..... | ..... | 175 |
| Australia | 2,993 | 2,341 | 10,220 | 6,202 |
| South Africa | 2 | 22 | 1,363 | 146 |
| Other countries | 2 | 115 | 551 | 234 |
| Base bullion (content) | 1,001 | 1,982 | 13,339 | 9,241 |
| Mexico | 1,001 | 1,982 | 12,927 | 9,241 |
| Other countries | ..... | ..... | 412 | ..... |
| Pigs and bars | 16,929 | 21,335 | 34,527 | 85,267 |
| Mexico | 16,845 | 10,712 | 28,882 | 51,908 |
| Peru | 84 | 1,311 | 2,772 | 13,631 |
| Australia | ..... | 2,862 | 2,800 | 11,514 |
| Canada | ..... | 6,450 | 73 | 8,214 |

**California's small but important gold producer, the Alhambra mine, of the Alhambra-Shumway Mining Co., near Kelsey, Eldorado County, continues development in depth on two new orebodies**

# CALIFORNIA

## Exploration Planned For Scales Mine

**Shattuck Denn Mining Corporation preparing to exploit placer area—Gravel being tested on Hoopa Valley Indian Reservation**

▶ Exploration work is scheduled to be started soon at the Scales mine, situated in the Port Wine placer area near the border of Yuba and Sierra Counties and taken over recently by Shattuck Denn Mining Corp., operators of the Denn copper property at Lowell, Ariz. The mine was operated in 1935 and 1936 by hydraulic methods by the former owners, the Scales Placer Mining Co. Extension of a power line to the mine workings has been completed, which will facilitate operation of equipment by electricity in addition to the available water system.

▶ Lobicasa Co., of Sacramento, is testing gravel ground on the Hoopa Valley Indian Reservation in Humboldt County, and a large dragline dredge will be installed if satisfactory results are obtained. The area in question extends about 6 miles along the Trinity River, and averages 200 yd. in width. H. S. Lord is manager of the company.

▶ Extensive development work and installation of a mill are in progress at the Feliciana mine, in Mariposa County, acquired some time ago by Russell J. Wilson, former operator of the Black Oak mine, in El Dorado County. Broken ore is treated temporarily at the nearby Buffalo mill, and exploratory work is carried on 250 ft. below the old workings. William Bessler, superintendent, is in charge of operations.

▶ About 40 men are now employed at the Mt. Gaines mine, near Hornitos, Mariposa County, with the mill handling 1,500 tons of ore a month. A substantial tonnage has been opened up by development work started more than a year ago. Operations are directed by Vance Udell, superintendent.

▶ Operations have been resumed at the property of Caledonia Development Co. near Downieville, Sierra County. Equipment for treating mined gravel has been rehabilitated and improved. John Daniell, engineer, is in charge of operations.

## Extra Copies of Vol. I, No. 1

**IF THE REPRODUCTION of the first issue of the *American Journal of Mining* strikes your fancy, you can obtain additional copies for 25c. each. You may find something in Vol. I, No. 1 that is reminiscent of the mining experience of your family, or that would be of interest to an old friend or to descendants of pioneers who helped open the West by developing its mineral resources. Address your requests to the Editor, *E.&M.J.*, 330 West 42d St., New York, N. Y.**

# UTAH

## Utah Copper to Build Large Power Plant

**Company planning $5,000,000 steam-generating power center to supply current before June 1, 1943—Lack of foreign lead concentrates forces Murray smelter to suspend operations temporarily**

▶ Construction of a $5,000,000 steam-generating plant for the manufacture of electrical power by the Utah Copper Co. was announced recently by D. D. Moffat, vice president and general manager. The plant will be situated near the company's flotation plants at Magna and Arthur. It will be maintained with a capacity of 75,000 kw. for supplying power to Utah Copper operations only. The company's contract with the Utah Power & Light Co. expires about June 1, 1943, and Mr. Moffat says it is the plan of the company to have the new generating plant ready for operations in the spring of the same year.

▶ Utah Copper's open-pit mine at Bingham, working at full capacity, is turning out 80,000 tons of low-grade ore every 25 hours. The Magna and Arthur mills are producing daily concentrates containing approximately 800 tons of copper.

▶ Effective Aug. 1, Utah Copper will advance wages of day-rate employees 25c. per day. This is the third 25c. increase since Jan. 1. About 4,400 workers will receive the pay increase.

▶ Failure of lead ore and concentrates to arrive from Australia and South America on schedule, because of a lack of shipping facilities, will force the American Smelting & Refining Co.'s Lead smelter at Murray to shut down July 27 for six or eight weeks, announces William J. O'Connor, manager of the Utah department. Three hundred em-

**View of Thaynes shaft and conveyor belt installation for handling waste at the Silver King Coalition Mines Co., Park City, Utah**

ployees will be laid off. The company hopes to reopen the smelter on or about Oct. 1, 1941.

▶ Base rate pay for Utah metal miners advanced, as of July 1, 1941, 50c. a day to $6.45 for an eight-hour shift. Negotiations, successfully concluded when members of the International Union of Mine, Mill and Smelter Workers voted to accept the new schedule of wages, provided that the basic rate prevails regardless of metal prices, eliminating the sliding scale operating in the agreement setting 1940–41 wage rates. James W. Wade, general manager of the Tintic Standard Mining Co., was spokesman for operators, and Dan Edwards, president of district union No. 2, for employees.

▶ Five unions, each claiming jurisdiction over employees of the Utah Copper Co., submitted arguments during a three-day hearing closing on July 12 in the Federal Building. Henry J. Kent, national labor relations trial examiner, presided. Louis Buchman, general superintendent of Utah Copper mine operations, was the chief witness for the company. Three American Federation of Labor unions made application for an election to designate the collective bargaining agents at the Bingham mine. Intervenors were Local 485, International Union of Mine, Mill and Smelter Workers, a CIO affiliate, and the Independent Association of Mine Workers, an unaffiliated unit.

▶ A strike in the Tintic Standard, carrying high values in lead and silver in new ground on the 900 level south of the main deposit, has stimulated interest in the East Tintic district. Consolidation of the North Lily Knight Co. with the North Lily Co. has been approved by stockholders.

▶ Officers of the Tintic Standard and the North Lily mines propose to develop jointly 112 acres of leased property through a mile-lond drift driven westerly from the 1,450 level of the Tintic Standard main shaft. Eureka Liley, Eureka Bullion, Big Hill, and Twentieth Century ground will be affected by the new agreement.

▶ Late in July, the Elton Tunnel of the National Tunnel & Mines Co. passed south of the Rood Shaft of the Utah Apex mine, thus completing the 24,000-ft. adit driven at a cost of $1,250,000. Diamond-drill holes tapping the shaft had gone dry, indicating that water has been lowered to the level of the tunnel, 2,475 ft. below the surface of the Bingham mine. The tunnel will be advanced east of the shaft for 1,000 ft. before mining of the old orebodies begins. Depth of the Rood shaft is 3,300 ft.

▶ The Kentucky-Utah Mining Co. is working on a copper orebody in its Big Cottonwood Canyon property, according to M. C. Morris, secretary, Salt Lake Stock Exchange Building. A shipment of 27 tons of ore from the new development assayed 3.5 percent copper, with low-grade values in silver and copper.

▶ The Lakeside Monarch Mining Co. is sinking a 200-ft. winze on ore at its property 17 miles north of Delle, Tooele County. A raise is also being driven from the tunnel level on ore.


BALL MILL LINERS MADE OF JOLIETTE AUSTENITIC MANGANESE STEEL

SOME FACTS ABOUT AUSTENITIC MANGANESE STEEL CASTINGS

▶ *Joliette Steel Limited produces castings of every description made of the various Carbon Steels and Alloy Steels but at least 75 per cent of the castings we make are made of Austenitic Manganese Steel.*

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▶ *Ball Mill Liners are excellent examples of such Wearing Parts. Because Austenitic Manganese Steel possesses the peculiar characteristic of hardening on the surface when pounded, the metal on the surface of Ball Mill Liners of Manganese Steel in service is found to be dense, hard and wear-resisting while the metal in the body of the Liners is tough but only moderately hard. As the hard surface wears away, a new one is formed by the pounding so that a new thin wear-resisting surface is constantly being created. The softer metal underneath this thin wear-resisting surface forms a tough body which resists shock and in so doing prevents cracking.*

▶ *Experience has shown that in grinding many types of materials the use of Ball Mill Liners made of Joliette Austenitic Manganese Steel has appreciably lowered maintenance costs.*

Please send communications about castings for export direct to our Plant at Joliette, Que., Canada

# Reflections from Washington

"MORE FOR DEFENSE" has necessarily become the new motto of industry. And the mining and smelting business of the country will not be able to escape the practice of the motto, whether it likes it or not.

The drastic nature of the application of this policy is perhaps best illustrated by recent events affecting the automobile business. Unofficially it became known during the latter part of July that the making of 1942 models of automobiles would be permitted on a basis of not over 50 percent of the 1941 activity. As a result, executives of automotive concerns are speeding up their reorganization plans. This is not the result of any desire on the part of official Washington to stop other kinds of business. It comes about largely from the shortage of raw materials.

Perhaps a shortage of metals, including copper, lead, and zinc, may prove the *automatic* barricade to manufacturing in many novelty and specialty fields which otherwise could carry on without interference by defense.

## Certainties

AT THE CLOSE OF JULY there appeared to be several prospects, some of them rather unpleasant to contemplate, which must be regarded as certainties. It is difficult to date these. Forecasts as to where they will become true are mere guesses. But certainly the following, among other, important prospects lie ahead:

1. Draftees will stay in the Army beyond one year. Also the National Guard.

2. Prices of goods will rise, despite strenuous and sincere efforts of OPACS to sit on the price lid.

3. Wage increases, forced by unionization, and new taxes will add to the difficulty of management; but will be only grudgingly recognized by official Washington as a proper factor in figuring prices of the future.

4. Unless Congress grants further price-control authority before fall, the incipient inflationary spiral may have serious consequences on the whole economy. Official Washington in late July confesses privately that the inflationary movement has got a bit out of hand already.

5. Shortage of mineral products, especially the important ferro-alloys and main non-ferrous metals, are proving the ultimate bottleneck in defense planning. Copper, lead, and zinc are going to be more serious in limiting activity a year from now than are supplies of aluminum, magnesium, or manganese.

6. Speed-up, even at greatly increased cost, and with some subsidy, is going to be asked of all metal miners and smelters.

7. Shutdown of many normal types of industry will probably be forced by metal shortage, unless the speed-up in primary metal production is more effective than even the most optimistic forecasts indicate.

## Priority Rating A-3 for Mining Equipment

**SUPPLEMENTING the announcement on page 34 of the July issue of *E.&M.J.*, a new preference rating order has been issued by OPM to facilitate the production of mining machinery and equipment. A blanket rating of A-3 has been issued to about 40 manufacturers, applicable to delivery of materials entering directly or indirectly into the construction of such equipment. It is designed to relieve an acute shortage of machinery for mining operations and beneficiation of ores.**

## Shortage Estimates

AN EFFORT HAS BEEN MADE to prepare official estimates as to the seriousness of prospective shortage of metals, minerals, and other strategic materials. The technic used was relatively simply. First, the direct defense requirements were estimated. Second, the maximum production or supply is forecast. The difference between supply and defense need is the amount available for civilian use. Then the ratio is taken between the prospective *civilian desire* and this residual *available supply*. The result has been the following series of ratios (desire: supply) which apparently will apply to 1942:

| | |
|---|---|
| Aluminum, 15 to 1 | Nickel, 2 to 1 |
| Alloy steels, 2 to 1 | Nitrates, 8 to 7 |
| Chromite, 3 to 2 | Plastics, 3 to 2 |
| Copper, 5 to 2 | Power, 10 to 9 |
| Cork, 10 to 1 | Rubber, 10 to 7 |
| Lead, 1 to 1-minus | Steel, 10 to 9 |
| Manganese, 3 to 2 | Tin, 3 to 2 |
| Mercury, 3 to 2 | Tungsten, 2 to 1 |
| Mica, 3 to 1 | Zinc, 3 to 2 |

## More Copper

EVEN IF ALL THE SHIPS we want are available to bring RFC purchases of copper from Latin America, which is unlikely, we will still need more copper in the United States next year. OPM is convinced of this; and it has started to do something about it. Two plans are under way:

1. Direct subsidy of high-cost producers is contemplated. No official announcements have been made, but a suggestion on Aug. 5 by Mr. Henderson that producers whose costs were in excess of 11c. a pound the first six months of 1941 could be paid by Metals Reserve Co. 1c. a pound above "out-of-pocket costs," gave a strong hint what was being considered. "Out-of-pocket costs" was defined as costs exclusive of depreciation, depletion, and amortization of deferred charges. The costs of each company seeking this proposed premium would be determined by independent audit. Mine operators doubt that such a proposed measure would stimulate much mine development by high-cost producers so they could increase their production.

2. Conferences were held in July with all important copper producers meeting jointly with OPM priorities and OPACS price officials. Further conferences are to be held with each individual firm "to determine the quickest and most feasible methods to bring out additional tonnage." Each case will be considered according to its technical nature. Each mining enterprise is being encouraged to use new techniques, no matter how unconventional, just so long as they produce more of the red metal. Industry estimates are that 150,000 to 200,000 tons more copper per year may result.

To make present and prospective supplies of copper reach as far as possible, control was extended to cover copper-base alloys and fabricated products. Despite all controls it is officially expected that demands this year (1941) will reach 1,950,000 tons of copper, and thus exceed prospective total supply by 350,000 tons.

## Hemisphere Metals

SECURING NON-FERROUS METALS in adequate quantity is the job that has stirred government officials to considerable contracting for Latin American and Canadian supplies. It is expected that this program will be expanded further. Almost any country which can furnish copper, lead, zinc, or other needed metals can find a ready buyer at RFC.

On July 18 Metals Reserve Co. announced that it had bought 225,000 tons of Canadian and Mexican pig lead. About one-fourth of this is immediately available from the stockpiles of the companies making these contracts. Purchase price is 3.75c. a pound without duty at Laredo, Texas, and Trail, British Columbia. It is hoped that this price will stimulate further Mexican production.

All Argentine zinc ore which is available has also been purchased by Metals Reserve Co. Arrangements have also been made to purchase from Brazil all of its output of at least eleven important strategic materials. Those unofficially named for purchase are rubber, manganese, industrial diamonds, mica, quartz crystal, rutile (a titanium ore), nickel, zirconium, bauxite, chromite, and beryl ores.

Negotiations were also under way during July to secure more surplus lead from Peru. Obviously these arrangements are only the beginning of the Hemisphere metals program.

# THE TWO "WHYS" OF PENTASOL AMYL XANTHATE'S GREATER COLLECTOR POWER

**ON MANY ORES**, it's been proved that Pentasol Amyl Xanthate is "tops" in getting higher recovery at lower cost.

Slow-floating minerals in general respond best to Pentasol Amyl Xanthate. Arsenopyrite, metallic gold and pentlandite are examples. Sulphides and metallics, semi-oxidized sulphides, and some non-sulphides such as oxidized lead minerals, are also unusually responsive to Pentasol Amyl Xanthate —and for two important reasons:

❶—All these minerals are generally classed as hard to float, requiring greater collector power than other nonferrous minerals commonly treated by flotation. And the Amyls have long been recognized as the most powerful collectors of all the xanthates.

❷—Pentasol Amyl Xanthate is made from Sharples Pentasol (Mining Grade), a blend of five fractions of Sharples Amyl Alcohol.

Try Pentasol Amyl Xanthate on your ore. The commercial product is Bear Brand Xanthate Z-6, manufactured by Great Western Division, The Dow Chemical Company. Let us have samples sent to you.

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## Aluminum Contracts

SEVEN CONTRACTS for new plants to enlarge aluminum production were recommended by OPM during mid-July. In the aggregate, the seven new plants, to be financed by RFC, will produce 600,000,000 lb. per year. The aggregate supply, domestic and imported, for this country, effective sometime in 1942, will be 1,600,000,000 lb.

The Bureau of Mines has recommended that alumina for some of the new plants be developed from domestic alunite deposits in Utah. This may be necessary, as the alumina capacity of the country will not suffice for all the projected metal-reduction works.

No decision has been made regarding this alunite matter, nor has (up to the end of July) any final arrangement been made for other alumina manufacture except at one plant. That plant to be built by Aluminum Company of America in Arkansas will treat both low-grade and high-grade bauxite. But it is expected to supply alumina for only about 200,000,000 lb. per year of metal. Arrangements remain to be made, therefore, for the other two-thirds of the new projected metal supply.

## New Priority Units

PART OF THE new commodity organization of OPM was announced on July 17 by Director Stettinius. Working under him is Deputy Director Philip D. Reed, who is in charge of these priority problems affecting mining and metals. The Assistant Deputy Director is C. H. Matthiessen, Jr. Dr. C. K. Leith continues as Technical Consultant. Section 1 of this commodity branch will deal with rubber, synthetic rubber, and cork. All of the other sections are of importance to mining and minerals. The following list indicates the new set-up with the exception of the stockpiling unit, for which a consultant is to be named later.

Section 2. Chief: David A. Uebelacker—Nickel.

Section 3. Chief: Harris K. Masters—Tungsten, molybdenum, vanadium, cobalt, antimony, beryllium.

Section 4. Chief: John A. Church—Copper, zinc, brass, other copper alloys, cadmium.

Section 5. Chief: Andrew Leith—Manganese, chrome, ferrosilicon, zircon, titanium and rutile, columbium, tantalum, and their alloys.

Section 6. Chief: Erwin Vogelsang—Tin, lead, ilmenite (pigment).

Section 7. Chief: Howard Sykes—Mica, fluorspar, cryolite, graphite, magnesite, gypsum.

Section 8. Chief: Richard J. Lund—Asbestos, mercury, industrial diamonds, quartz crystals, platinum metals, radium, uranium, kyanite, abrasives, diamond dies, jewel bearings.

## Silver Replaces Tin

SHORTAGE OF TIN may force rapid industrialization of silver. This may go so far as to cause the government's reserve stock of metal to be drawn on should commercial supplies be short. Most immediate factor to this end is the proposal from National Academy of Sciences to OPM that silver be substituted extensively for tin in solder.

The Academy report points out that 2.5 to 5 lb. of silver replaces 40 to 50 lb. of tin. Hence, the cost of the silver solder would be slightly, if any, above the high tin solder normally used for many purposes.

## Priorities in Force

AT THE BEGINNING of the fiscal year in July, Priority Director Stettinius issued a summary of the status of his activities. This clearly showed that the mining and metal industries are bearing the brunt of priority burdens at present.

The list of 15 materials under full industry-wide priority control is: Aluminum, magnesium, chromium, nickel, nickel-steel, ferrotungsten, high-speed tungsten steel, machine tools, synthetic rubber, copper, cork, borax, polyvinyl chloride, zinc, and rubber.

A form of inventory control is applied to the following commodities: Antimony, cadmium, cobalt, ferrous alloys, iridium, iron and steel products, lead, manganese, mercury, molybdenum, nonferrous alloys, vanadium, and certain secondary metals.

Certain commodities like steel are subject to both preference ratings and inventory control. On the "Priorities Critical List" there are 300 items or classes of goods to which individual priority ratings may be granted to insure delivery of equipment and materials on Army and Navy contracts. Some of these are also subject to wide supplemental controls, even where not on either of the two lists above.

The newest policy of regulation is the "defense supplies rating plan," which applies to the rationing of goods in a little less formal fashion than under priority rulings.

## News "Fines"

**Lead Buying**—Officials of OPM are urging those who want lead, first to make attempt to get their supplies through regular channels. They do not wish would-be purchasers to come to Washington asking for a priority until they have exhausted commercial resources.

**More Nickel**—Joint action of Canadian and American authorities has been taken on several commodities through Materials Coordination Committee. Action of late July makes possible the supply of 20 percent more nickel from Canada to United States users.

**Black List**—Uncle Sam now has a list of Latin American concerns with which it is desired that no one do business. Any person who has Latin American connections in the mining, equipment, or mineral business should make sure that his affairs do not get connected with these proscribed folks.

**Priority Training**—It is recognized that business firms are going to have difficulty meeting priority rules, especially as they get more complicated. Therefore, the priorities division of OPM is operating short training courses for the education of groups who need this assistance. Coherent groups from industry that need this help should apply for their training clinic. Arrangements will be made by the office of Priorities Director E. R. Stettinius, Jr.

**Forced Substitution**—If a customer orders 50 lb. of high-speed tool steel, OPM now expects him to order 25 lb. of the molybdenum type in order to get 25 lb. of high-tungsten alloy. This is an effort of OPM to stretch limited supplies of metals like tungster, for which the shortage is most acute. It does not take the place of rationing or priority allocations; it merely supplements them.

**Russian Relations**—Washington is willing to do business with Russia to the fullest possible extent. Shortage of shipping will severely limit the good intentions of both sides. Only most urgently needed materials can be handled as this trade develops, regardless of credit and other considerations.

**Silver Buying**—Secretary of the Treasury Morgenthau has promised Western senators that there will be no sudden change in the policy of buying domestic virgin silver. Congress, therefore, is not attempting any new legislation fixing the price, and this will doubtless continue at 71.11c. per fine ounce.

**Chromite Refractory**—As a part of the program of controlling chromium supplies, all defense materials not otherwise given preference will have a priority rating of A-10. This includes deliveries of chromite refractories which may be made only under defense orders or for absolutely necessary maintenance and repair work. Close control of inventories is required also.

**Train-Load Rates**—To offset the difficulty of moving bulk goods by land, the Interstate Commerce Commission is now recognizing train-load rates for certain commodities. They have also lowered certain high carload rates—for example, on sulphur—so that the rail movement cost will not be prohibitive.

**Iron for Precipitating Cu**—The need of scrap iron for precipitating copper from mine waste water has been recognized by OPACS. It has, therefore, established a selling price and allowed interested mining companies to procure required quantities.

**Magnesium Plants**—During July OPM finally recommended at least four new magnesium plant projects. Four firms in the chemical industry will, therefore, proceed using some process for electrolysis of anhydrous magnesium chloride. Advisory assistance of Dow Chemical Co. has been provided for these new firms through the helpful influence of government officials. If these plants are completed by 1942 mid-year, as hoped, the country's capacity will be equal approximately half of the projected 400,000,000 lb. per year. Negotiations in Washington are, therefore, expected to continue and several additional producers may be put under contract within the next month or two.

**Zinc Controls**—Supplementing diversion of zinc for reserve stocks there are now numerous additional restrictions on marketing. For example, galvanizers who redistill zinc dross or skimmings have been ruled to be producers of zinc. They are required to set aside a specified proportion of recovered zinc, just as do primary producers. Control on commission agencies is also more rigid. Additional warnings have been issued about the pricing of material which has been stretched by allowing dirt or undersirable contamination to remain in the weighed shipments. Both OPACS and OPM officials intend to tighten up on this situation if the industry does not exercise closer self-discipline, it is reported.

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Today's production tasks, and the preparations for the many economic and technical adjustments which lie ahead, indeed make this Diamond Jubilee edition a fitting symbol of "E&MJ's" past indespensable services to our entire organization—and, as well, a reminder of this journal's continued importance in helping to solve the problems ahead.

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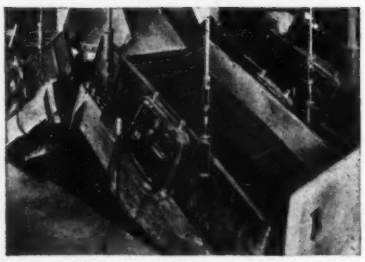

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At Rio Tinto, Nev., is this 350-ton flotation mill of the Mountain City Copper Co. At the mine and town site three 667-kva. transformers have been installed to permit changing transmission line voltage from 44,000 to 6,000 v.

# NEVADA

## Deep Drilling Under Way in Pioche District

**American Metal Company prospecting possibilities in southwestern part of area—Tungsten plant near completion near Cherry Creek**

▶ American Metal Co., Ltd., is prospecting claims in the southeastern part of the Pioche district by deep diamond drilling, conducted under contract by the E. J. Longyear Co., of Minneapolis, for determination of lead-zinc orebodies. In this area claims are owned by the International Smelting & Refining Co., which carried on some prospect work last year. Farther east at the Caselton shaft of the Combined Metals Reduction Co., a 500-ton selective-flotation mill was reported nearly ready to crush ore. Mines at Pioche produce silver, lead, gold, zinc, and manganese. In charge for the American Metal Co. Ltd. at Pioche are J. T. Matson, manager for the subsidiary American Metal Co. of New Mexico, and John Payne, Jr., field engineer, who have spent the past two months in a general survey of the district.

▶ The mill of the Cherry Creek Tungsten Mining Co., near Cherry Creek, Nev. is under construction by the Galigher Co., Salt Lake City, Utah for the Molybdenum Corporation of America. The plant is unique in that it employs a nearly straight flotation process for the recovery of scheelite from the original ore. Operations are expected to begin late in August.

▶ Near the old camp of Palmetto, in southern Esmeralda County, deposits of talc that have been worked at long intervals are now producing in substantial volume. The Sierra Talc Co. is reported to be working three shifts and shipping 400 tons monthly. Smaller shipments have been made by several other claim owners.

▶ A crosscut tunnel on property of the Mountain City Consolidated Copper Co., adjoining the Rio Tinto mine, in northern Elko County, has advanced 100 ft. in ore sampling 2 percent copper and in 75 ft. will reach a point under the shaft that is in similar ore to the 250-ft. level and in which work was halted last year by water difficulty. M. E. Bohannan, of Mountain City, is manager.

▶ At the Jumbo gold mine, in the Awakening district of Humboldt County, the amalgamating and concentrating mill has been treating 70 to 80 tons per day with mill heads at $4 to $5 per ton when no selective mining is done. Costs, with open-cut mining and 3-mile truck haul to the mill, were reported to be under $2 per ton.

▶ Placer ground embracing some 4,000 acres and covering an alluvial fan at the outlet of Philadelphia Canyon, 16 miles south of Battle Mountain, Lander County, has been acquired by James O. Greenan and is being tested by drilling and shaft sinking. The ground adjoins on the north the 7,000-acre tract of the Greenan Placers, Inc., test work on which has proved some 60,000,000 cu.yd. of gravel with average content of more than 20c-gold per yard. To provide dredging equipment the Federal RFC has authorized an advance of $1,050,000 to the Greenan Placers, Inc. This fund is now available, but some delay is foreseen in securing delivery of a large-capacity bucket-line dredge in view of current priority restrictions. W. G. Donaldson is directing engineer.

▶ Mine equipment and camp facilities have been provided at a scheelite deposit 20 miles east of Austin, in Lander County, secured lately under option by John Heiser, field engineer for the Nevada-Massachusetts Co. and affiliated concerns, from Stephen Linka, the discoverer.

▶ The Galigher Co., Salt Lake City, Utah, has designed and has under construction for the Bureau of Mines, a pilot manganese concentrator, a pyrometallurgical manganese plant, a hydrometallurgical plant and a pilot electrolytic manganese plant, all to be at Boulder City, Nev.

▶ Construction of an all-new 120-ton cyanide mill is to be started soon by the Central Comstock Mines Corp. on the site of the 400-ton flotation mill operated formerly by the Arizona Comstock Corp., the Central Comstock having obtained, through action of the

Federal district court, a long-term option for $625,000 on the Savage, Hale & Norcross, Chollar and Potosi mines on the Comstock lode at Virginia City. A. D. Vencill, of Los Angeles, is president, A. E. Vandercook manager, Gordon Smith mine superintendent, and C. T. Mills construction engineer.

# WASHINGTON

## Sierra Zinc Co. Starts Operations

**Newly formed organization is completing a 70-ton concentrator near Northport—Deertrail Monitor Mines Co. developing molybdenum deposits**

▶ Sierra Zinc Co. has been organized to handle the old Blue Ridge zinc-lead property, 7 miles east of Northport. R. K. Magney, of Spokane, reports the company is constructing a 70-ton mill, which will start operation in August.

▶ Deertrail Monitor Mines Co. has put its mill into operation in southwestern Stevens County and will produce molybdenum concentrates. J. Richard Brown, president and manager, says the company has been urged to do this by New York molybdenum agents. He will drift 100 ft. on the ore on a level 110 ft. below the tunnel. He reports the ore runs about six-tenths of 1 percent molybdenum.

▶ Joseph Schwendler, Buffalo, N. Y., and Francis M. Cameron, president and secretary-treasurer of Royal Development Co., inspected the company's property in July. The mine is 42 miles from Leavenworth. Joseph Winiarski, a graduate of Pittsburg University, has been appointed superintendentfl

▶ Two hundred feet of the tailings dam broke at the Knob Hill mine, at Republic on July 11. The dam, about 1,200 ft. long and 50 ft. high, had been weakened by heavy rains. It held hundreds of thousands of tons of tailings from the company's modern cyanide and flotation plant. No damage was done to the company's mill or mine, but boulders and uprooted trees were deposited on the highway, blocking traffic.

▶ Many cars of gold ore have been shipped so far this year by Methow Gold Corp. from the property of Alder Group Mining & Smelting Co., which it has under lease in Okanogan County. Under the terms of the lease 50 tons of ore are mined daily, leasers paying the owning company 12½ percent royalty on smelter returns. Production of 100 to 150 tons daily is estimated by President Mahlon McCain. Robert S. Lewis, of Fargo, N. D., president of the First National Bank, is president of the Alder Group company.

▶ J. R. Edson and W. F. Stevens, experienced miners from the Coeur d'Alenes, who have taken a lease on the property of Gladstone Mountain Mining Co., in northern Stevens County, plan to put in a small mill to handle both the lead carbonate and sulphide orebody in limestone.


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# ARIZONA

## Steady Output Maintained At Christmas Copper

**Production averaging 120 tons copper ore per day—Sink-and-float unit installed at Belcher and Wizard properties**

▶ The Christmas Copper Corp., of Christmas, Ariz., is producing 120 tons of copper ore daily. About 40 men are employed. George Kollenborn, of Winkelman, Ariz., is superintendent. Harrison Schmitt, of Silver City, N. M., is consulting engineer.

▶ An MBI patented sink-and-float unit licensed by the American Zinc, Lead & Smelting Co., of St. Louis, Mo., has been completed at the Belcher and Wizard properties, in the Big Bug district north of Mayer. The new equipment is handling about five tons per hour and operations started early in August. The property is owned by George Demaine, of Humboldt. James Corner, of Mayer, is superintendent.

▶ The Ord mercury mine, on Slate Creek, in Tonto Basin, is supplying its furnace with about 25 tons of ore every 24 hours. L. E. Foster, of Phoenix, is superintendent and engineer. The owner is W. V. Ranney, Box 32, Highland, Calif.

▶ A 50-ton flotation plant was recently completed at the Ruth mine, south of Prescott. Considerable development work is underway and the mill is expected to begin regular production soon. B. N. Meachem, of Long Beach, Calif., is owner of the property.

▶ The Tin Cup mine in the Secret Pass country 20 miles west of Kingman, has been shipping from 50 to 100 tons of gold ore daily to the Producers mill. A power shovel is employed removing overburden and ore. C. O. Hewen, at Kingman, is manager.

▶ The Tennessee-Schuykill Corp., operating the Tennessee mine, at Chloride, is shipping a carload of zinc and lead concentrates every day. Recent development in the lower levels has found some good ore. Jacob Shoder, of Chloride, Ariz., is general manager.

▶ About 750 tons of ore a month are being shipped from the Tombstone Development Co. property near Tombstone. Nearly 100 lessees are operating the property under the management of Jack B. Martin, Box 2110, Tucson, Ariz. The ore carries gold, silver, lead, and copper.

▶ The Arizona Chrysotile Asbestos Co., operating near Globe, is producing two to three tons of asbestos fiber daily. Five to ten tons of ore are daily being run through the mill on the property. Further development and increased production are planned. G. C. Liengle, of Globe, is president.

▶ The Copper Queen division of Phelps Dodge Corp. is mining 3,500 tons daily. More than 1,700 men are employed under the direction of H. C. Henrie.

▶ The Golden Door mine, 18 miles north from the Producers, Inc., mill is supplying about 100 tons of gold ore every 24 hours for treatment at the Producers mill. Dye and Batherick are operating the property.

Experimental milling plant in the new building

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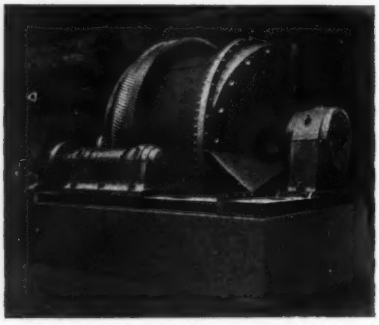

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At the mill of the London Mines & Milling Co. near Alma, Colo., about 225 tons of low-grade gold ore containing some silver and lead are being successfully treated by the gravity-and-flotation method of concentration. A short aerial tram connects the mine and mill. One of the tram towers is seen to the left of the plant.

# COLORADO

## Vanadium Producers at Capacity Operation

**Additional output will become available when plant of U. S. Vanadium Corporation at Rifle is completed—Alma Lincoln Mining Co. driving crosscut to reach Cardigan vein—Carlton tunnel completed two years ahead of schedule**

▶ Vanadium mines in southwestern Colorado are reported producing at capacity. A large part of the vanadium used in this country comes from the U. S. Vanadium Corp. of America's mine and plant at Uravan, Colo. The corporation is rehabilitating its plant at Rifle, which will add materially to its production.

▶ The Alma Lincoln Mining Co. has leased the Cardigan mine, which is just east of the Ellott and Barber group, and driving a crosscut from the main E&B adit to cut the Cardigan vein and extension of the Donna Juanita vein.

▶ July 23 officially marked the completion of the Carlton tunnel, near Cripple Creek, Colo., the objective of which is to drain the water from the lower working of several mines of the Golden Cycle Corp. The total footage was 32,262 ft., of which 31,600 ft. were on a straight line; 234 ft. on an offset heading near the Newmarket fault; and 428 ft. on a crosscut to a point directly under the Ajax shaft. Work started July 18, 1939, and, during the 670 days of operation a world's record in tunnel driving was achieved. John Austin was tunnel superintendent.

▶ The old Cripple Creek placer mining properties on the Moynahan flat in west Cripple Creek and on Wilson Creek near Victor are being operated by Jess O. Vetter, who has built a washing plant on Cripple Creek just below the city limits, capable of handling a hundred yards of gravel per day. He is using a power shovel on the mining site on Mineral hill and trucking the gravel to the washing plant.

▶ The Zenda Gold Mining Co. has made the following report: "The Resurrection Mining Co., which is operating under an option to purchase the northern portion of the subsidiary company's property at Leadville, has discontinued to work close to the southerly boundary of the Resurrection group and instead it has sunk the No. 2 shaft to explore the limestone formations at depth and towards the northwest. The shaft was sunk 260 ft. and a station cut 350 ft. below the Yak tunnel level, during the past year. A large hoist has been installed at the shaft and much development work done. In view of the amount of work being done by the Resurrection Mining Co., it would appear probable that it will exercise its option next January and make payments provided to the subsidiary company." The Resurrection mill is gradually being constructed and operations are expected to begin sometime in the early part of the last quarter.

▶ The Slide mine, on the north slope of Gold Hill, near Boulder, and under the direction of Ward E. Terry, has acquired nearly all the adjoining claims. This is the largest mine in the Gold Hill district. A 75-ton mill treats the ore. In diamond drilling, a tungsten vein on the Alton tunnel group has been reported cut.

▶ John and Earnest Strong, of Aspen, have recently located a vein of zinc ore 6 miles north of Glenwood Springs. Heavy snowslides have handicapped progress during the spring, but six men are now working building cabins and rehabilitating the property.

▶ The Longfellow Mining Co., leasing

from the Stratton Mining & Development Co., is reported shipping 2-oz. gold ore. Wallace K. Howard, representing a group of Boston business men, is in charge.

▶ The Fargo Mines Operators, under the management of Barlow Willmarth, at Georgetown, are now producing gold ore following two months of development work.

▶ Guy L. Emerson, president and treasurer of the Treasure Mountain Gold Mining Co., states that the company is pouring concrete foundations for the mill building and heavy machinery at the Treasure Mountain holdings in Picayune Gulch.

▶ Frank Straub, of Los Angeles, Calif., is planning to reopen the Old Sylvanite mine, on Copper Creek above Gothic.

▶ Excavation and foundation work has been started for the construction of a 100-ton mill on the south slope of Rosebud Hill just across the gulch from the El Paso mine, at Cripple Creek. This mill is sponsored by the Rockfield Equipment Co., of Denver, under the direction of manager E. E. Rockfield and in cooperation with the Gold Empire, Inc., of which John Kolman is president and manager. The mill will treat the ores from the Gold Empire properties.

▶ The Argentine mine of the Tomboy Gold Mines, Inc., is being rehabilitated. This property connects with the old Tomboy mine and work is carried on during only four months of the year. A small concentrating plant capable of handling about 30 tons is operated by Edward B. Ross.

## IDAHO

### Deeper Mining Planned at Hall-Interstate Mine

**Callahan-Zinc Lead Co. will determine downward extension of orebodies—Area near Ima tungsten mine being diamond drilled**

▶ The Callahan Zinc Lead Co. has started operations on the Hall-Interstate property in Valley County, recently acquired under lease and bond. Leverett Davis, mining engineer of Boise, is in charge of the operations. Years ago the property was opened by the Bunker Hill & Sullivan and some production made. The Callahan management will attempt to disclose orebodies by shaft sinking and development at greater depths than any previous operation.

▶ The U. S. Bureau of Mines has a crew of men engaged in diamond drilling in the Patterson, Idaho, area to determine the extent of the tungsten belt where the Ima tungsten mine is now producing high-grade ore.

▶ A deposit of manganese oxide 10 to 15 ft. wide is reported in the Pine Creek area of the Coeur d'Alenes by J. H. Eby, geologist, who recently made an examination of the property for the owners, who reside at Kellogg.

▶ Pilot Gold Dredging Co., of Prairie City, Oregon, has moved its gold dredge


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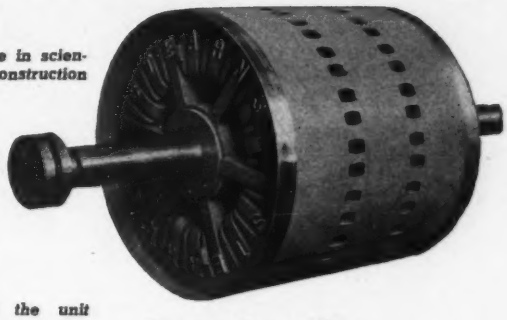

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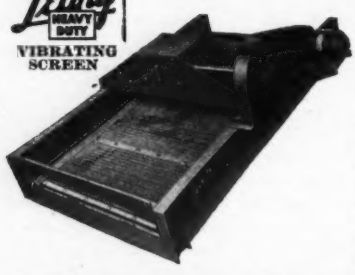

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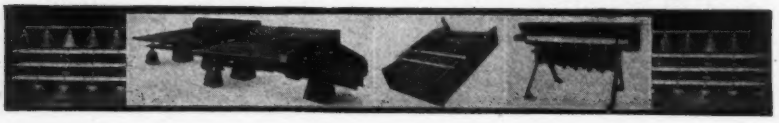


## ▶IDAHO

to Valley Creek, about 15 miles from Stanley, Idaho, in the Stanley basin placer district. Valley Creek is an old-time placer belt, and this marks the first dredge to operate in that section.

▶ The shaft at the Coeur d'Alene Mines property, in the silver belt, has now reached a depth of 1,800 ft. below the tunnel level and 400 ft. below the lowest working level. Sinking will continue to the 2,000 level with stations at 200-ft. intervals. The mill is treating 300 tons of ore per day, and machinery has been ordered to increase output to 600 tons daily.

▶ Sunshine Mining Co.'s net smelter returns for the second quarter were $1,243,429.90, bringing total 1941 net smelter returns for the half year to $2,703,715.40, according to a statement just issued by Ross D. Leisk, general manager. Net smelter returns for the first quarter were $1,460,285.50, leaving a decrease of $216,855.60 in second-quarter returns. "The production for this quarter showed an increase in tons milled of 7.5 percent, but a decrease in ounces of silver recovered of 14.8 percent, as compared with the first quarter. The decrease in production was due to lower mill head during the quarter," Manager Leisk stated.

▶ Hecla Mining Co. continues an active development program on the recently acquired Atlas property, south of Mullan. The drift from the 800 level of the shaft has progressed 500 ft. with mineralization the entire distance. A crosscut from the face of this east drift will be driven south to determine the width of the vein and further prospect the siderite vein cut in a former crosscut where silver and copper were found.

▶ United States Metals, Inc., a new company, has been formed to operate the old Bayhorse silver mine, across the Snake River from the Idaho line in Oregon, in the Seven Mile district. The company is building a 100-ton flotation plant at the mine to cost between $50,000 and $60,000. Huntington, Oregon, is the nearest railway shipping point.

# MONTANA

## Mill at Mike Horse Mine Starts Operations

**Lead-zinc plant has daily capacity of 150 tons—Montana Mining Association to meet**

▶ The 150-ton lead-zinc flotation plant built by the Galigher Co., Salt Lake City, for the Mike Horse Mining & Milling Co., went into operation in July. This plant is near Lincoln, and employs the use of Agitair countercurrent froth-flow system of flotation.

▶ The seventh annual convention of the Mining Association of Montana will be held at Cooke City-Silvergate, Park County, Mont. at the northeast entrance of Yellowstone National Park, Sept. 5 and 6. There will be addresses on geogphysical prospecting and strategic

minerals by Dr. Francis A. Thomson, president of the Montana School of Mines; Dr. E. S. Perry and Dr. George L. Shue, members of the schools staff; Dr. L. M. Farner, Director, and H. T. Walworth, engineer, of the newly established Montana Department of Industrial Hygiene, will outline the work and aims of their organization. Chairman J. C. Archibald, Helena, of the Gold Committee; Chairman Stanley R. Moore, Wilborn, of the Workman's Compensation Committe, and Chairman John Schroeder, Helena, of the Placer Committee will submit their first annual reports. Carl J. Trauerman is president of the Mining Association of Montana.

# ALASKA

## Placer Mining Attracts Interest of Soldiers

**Week-ends spent in panning gold near Anchorage—Labor strike at Fairbanks Exploration Co. settled**

▶ United States soldiers stationed near Anchorage have discovered placer gold and located several claims on ground Alaska miners have tramped over for many years. The location is the Little Susitna River, below Fishook Inn. The soldier-miners are divided into two groups, one under Major M. R. Marston, of the Air Corps, and the other under Lieutenant Lind. Each group will have about 15 men, who will spend their week-ends panning or sluicing for gold. One claim located is named after General Buckner, commander of the Alaska Defense Command. Two soldiers prospecting came upon Dan Gray, an old-time prospector who has been there eleven years. They pooled their interests and the three are working together. One claim, called the White Water, has been assigned to the "Gold Seekers Club" at Fort Richardson.

▶ Dr. Harrison L. Davis, at Los Angeles, Calif., and associates, are planning a survey of a sulphur deposit, 10 miles inland from Bales Landing, Stepovak Bay, on the east side of the Seward Peninsula.

▶ Boundary Dredging Co. recently moved its dredge down the river to Canyon Creek and is assemblying it near Boundary. The crew consists of 45 men.

▶ S. A. Liening and Wyman Anderson are developing the Old Greek property for the Falls Creek Mining Co.

▶ Members of the C.I.O. Mine, Mill and Smelter Workers Union, after a 37 days' strike against the Fairbanks Exploration Co., returned to work under a new contract, calling for a 10c. wage increase, improved camp conditions, seniority rights, and an agreement that no discrimination would be made against men for union affiliations. The agreement was accepted by 70 percent of the men.

▶ Nabesna Mining Corp. has completed a new tunnel site, compressor house, and other buildings at its new camp at the Golden Eagle property, where it has a 100-ft. tunnel into promising orebodies.


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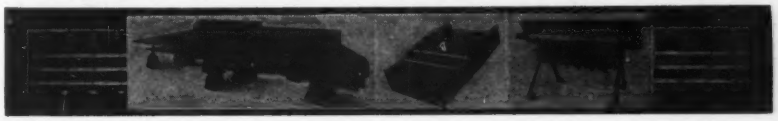

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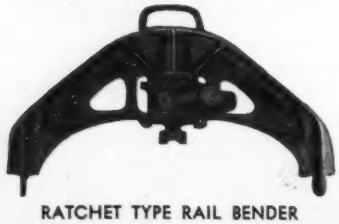


RATCHET TYPE RAIL BENDER

**Considered the largest and most modern concentrator to be built in the Missouri section of the Tri-State, the above plant of Kansas Explorations, has a capacity of 50 tons of ore per hour.**

# TRI-STATE

## Kansas Explorations, Inc., Begins Mill Operation

**Subsidiary of St. Joseph Lead Co. has modern plant in Missouri section—Peak of zinc concentrate output at present price levels believed near**

▶ With the addition of the new Snapp mill of Kansas Explorations, Inc., in the Tri-State district, the total number of active mills had increased by the middle of July to 60—the largest number since the latter part of 1937. When the Snapp mill, situated 2½ miles northeast of Oronogo, attains capacity output in August, production of district should average from 9,250 to 9,750 tons weekly, depending on operation schedule and grade of ore handled at the big Central mill of the Eagle-Picher Mining & Smelting Co., which, due to its large capacity, may cause a variance of 500 tons, or more, from week to week. The huge Eagle-Picher plant handled around 300,000 tons of ore in July. Rehabilitation of the Granby-American mill and reopening of the Granby mines of the Federal Mining & Smelting Co. should be completed in another month, and this added production may increase the weekly total to a peak of 10,000 tons, which is about the extent of all-out zinc concentrate output here on the present price.

▶ Kansas Explorations' Snapp mill is the largest and most modern concentrator to be built in the Missouri section of the Tri-State district in many years. The mill has a capacity of 50 tons of ore an hour, and was designed by Ross Blake, of Joplin, district manager of the company, who also directed its construction as well as the new mine development on the Snapp land. George Scheurich, of Joplin, was the millwright. Development on the Snapp fee, which is owned by the company, a subsidiary of the St. Joseph Lead Co., was started in January, following a drilling campaign late last year. John Mill is foreman and Royal Sullivan is in charge of milling operations.

▶ Brugger Mines, Inc., has reopened the No. 3 mine on the Brugger land, a 158-acre tract a mile northwest of Baxter Springs, according to Dr. C. W. McCarty, of Tulsa. Mine operations are on at the 90-ft. level, and ore is being trucked to the Royal custom mill of the United Zinc Corp., southeast of Picher, for treatment. Clint Nunn, of Baxter Springs, is superintendent.

▶ The Britt Mining Co. has reopened the old Pioneer Lead & Zinc Co. lease, a mile and one-half southwest of Cardin. Carl Britt, of Miami, is president. Ore is trucked to the Eagle-Picher Central mill for treatment.

▶ Claude O. Stum and associates, of Joplin, are reopening a shaft on the O'Keefe land, a half-mile northwest of Four Corners near Joplin. Associated with Stum are Rodney and Ray Moore.

▶ St. Louis Smelting & Refining Co. has installed a 10-in. turbine pump on the High Five lease in the Waco area. A derrick and 350-ton hopper from the No. 19 shaft on the Freehold lease has been moved to the High Five shaft, which will be dewatered to the 260-ft. level. Ore will be trucked to the company's No. 9 plant.

# IRON COUNTRY

## Ore Shipments Continue At Record Volume

**About 75,000,000 long tons estimated for the 1941 season—Large borehole at Zenith mine to be converted into a shaft**

▶ Total shipments of iron ore from Upper Lake ports in July were 11,390,488 long tons, against 10,433,488 tons for the same period last year. Shipments to date this year total 40,216,408 tons. At the present rate it is estimated shipments in 1941 will reach 75,000,000 tons.

### Vermilion Range

▶ The 5½-ft. diameter borehole at the Zenith mine of the Pickands, Mather & Co., Ely, Minn., will be enlarged and made into a five-compartment production shaft. It is estimated the work will require about six months to complete.

### Cuyuna Range

▶ Inland Steel Co. has purchased the fee to the Armour No. 2 mine, at Crosby, Minn. In making the announcement Clarence B. Randall, vice president in charge of raw materials, also said: "I wish that I might announce also that we are preparing to reopen the property, but such, unfortunately, is not the case. Even in the current emergency we are not able to find a place for the output of this mine in the consumption of our blast furnaces, and the property will, therefore, have to be carried as a reserve."

### Marquette Range

▶ Fire in old timbers in one part of the Athens mines, operated by the Cleveland-Cliffs Iron Co., in the Negaunee field, has been extinguished, and the mine is again producing. A raise was driven from which a drift was directed above the fire zone on the sublevel of the sixth level about 2,000 ft. below the surface. Miners at the property were given a week's vacation with pay while the mine was shut down. Work resumed July 12. S. R. Elliott is mining manager of the Cleveland-Cliffs company. Representatives of the U. S. Bureau of Mines aided in extinguishing the fire.

### Menominee Range

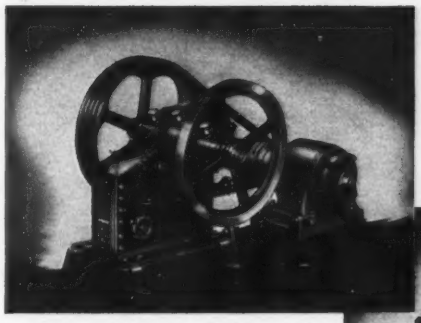
▶ Engineeers of the Globe Iron Co., Jackson, Ohio, have started testing the area around the old Cuff mine, which the company has under option. The company also operates the Cornell iron ore mine, of which William Doell is superintendent. Ore is shipped from Iron Mountain to Escanaba by rail; by boat to Toledo, and rail to the furnaces at Jackson, Ohio.

▶ Early in July it was learned that the Zimmerman mine of the M. A. Hanna Co. will be reopened. G. M. Cannon, assistant general manager of the company made the following announcement: "The M. A. Hanna company announces that work will be started at once to unwater the Zimmerman mine and get it cleaned up and ready for production late in the fall. Frank E. Keese, superintendent of the Bates mine, will also be superintendent of the Zimmerman.

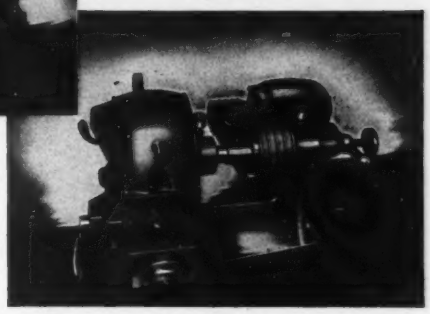
### Gogebic Range

▶ Operations were discontinued at the Ironton mine by the Republic Steel Corp. on July 19 due to depletion of ore reserves.

▶ The County of Gogebic, in Michigan, plans to engage an engineer or geologist for the purpose of determining the valuation for tax purposes of mines in the county. The person selected will be appointed by the county board of supervisors as an assistant deputy mine inspector.

*Braun Chipmunk Crusher with V-Belt Drive*



*Braun UA Pulverizer with V-Belt Drive*

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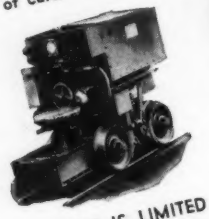

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# ARKANSAS

## New Aluminum Plant To Be Erected

**Annual capacity will be about 100,000,000 lb of metallic aluminum—Diamond fields in State showing more activity**

▶ The Office of Production Management in Washington has announced that a plant for the production of metallic aluminum is to be built in Arkansas, the work on it to start immediately. Erection of this plant is part of a larger program of the Government to increase the nation's aluminum supply during the present defense emergency. The plant is to be built by the Federal Government, but it will be operated under lease by the Aluminum Company of America. Arkansas has been selected for the location because of the availability of large reserves of cheap natural gas in the McKamie and Dorcheat fields in the southwestern part of the State, and because of bauxite deposits in the State. In recent years Arkansas has been the chief domestic source of bauxite, the ore of aluminum, and in 1939 the State produced 96 percent of the supply mined within the United States.

▶ The Arkansas plant will have an annual capacity of 100,000,000 lb. of metallic aluminum. The plant is to be located in southern Arkansas, most probably near the town of Camden on the Ouachita River, where there is an ample water supply and favorable transportation facilities. An immediate power supply of 120,000 kw. will be available on an emergency basis through transmission interconnections which could be completed in six to nine months. This capacity will include 68,000 kw. through utilization of reserves of various companies, and 67,500 kw. from the Brazos and Grand River hydro developments, and the Gilmer, Tex., and Arsenal Hill, La., diesel plants now under construction. The ultimate source of power will be two steam stations fired by natural gas, capable of producing 180,000 kw. The aluminum plant will be so situated as to make available for use as fuel the abundant "sour" gas supply of southwestern Arkansas. The Arkansas Oil and Gas Commission estimates reserves of 700 billion cubic feet in the McKamie field, and 91 billion cubic feet in the Dorcheat field. This gas contains relatively large amounts of hydrogen sulphide. The gas will be desulphurized before its use as fuel in the steam plants. If necessary it will be possible to manufacture an additional 100,000,000 lb. of aluminum when the new gas-fired steam plants are built.

▶ The Arkansas diamond mining region, located in southern Pike County near Murfreesboro, shows signs of renewed activity. Recently work on a small scale has been carried on at the old American mine, on the property of E. B. Bird. The mining is done in shallow open cuts in weathered peridotite, the rock in which the diamonds are found. Weathered rock is broken into small pieces by pick and shovel, and washed and jigged by hand, after which it is carefully picked over and searched for diamonds. No information is available as to the number of diamonds recovered since this work began this spring.

▶ The sale of the long-idle Arkansas Diamond Corp.'s mine in the Prairie Creek area of Pike County was completed July 2. This property, covering the greater part of the largest of the three diamond-bearing peridotite areas near Murfreesboro, was formerly owned and operated by the above-mentioned company, but full-scale operations had not been carried on since late in 1920. However, during the 'twenties the Arkansas Diamond Corp. continued to recover diamonds from the area on a reduced scale of operation. Since 1932 there has been no reported production. The property, which sold for $175,000, has been acquired by the recently formed North American Diamond Corp., which was represented in the sale by Robert J. Arthur and Edwin T. Schneberger, lawyers from Logansport, Ind., and Chicago, respectively. The new company plans to operate the property with the recovery of diamonds for industrial use primarily. Engineering studies to work out the local details of the recovery processes have been completed, and mining operations are expected to begin soon.

**Workmen watching start of flow of virgin aluminum at the new Reynolds Metals Co. plant at Listerhill, Ala. in the Muscle Shoals district. The first aluminum in this plant was produced in less than six months from the start of construction. More than one hundred million pounds of aluminum will be produced each year in the two plants of the company. The Longview, Washington, Reynolds Metals aluminum plant is expected to be in production sometime in July or August**

## Seven New United States Aluminum Plants

The office of Production Management has recommended five companies to operate seven new government-owned aluminum plants to increase output by 600,000,000 lb. a year.

The plants, their capacities, and the sites tentatively recommended to the War Department are:

Aluminum Company of America, three

plants; one of 100,000,000 lb. capacity in Arkansas, one of 90,000,000 lb. capacity in Booneville-Grand Coulee district, and a third of 150,000,000 lb. at Massena, N. Y.

Union Carbide & Carbon Co., one plant, 60,000,000 lb. at Spokane, Wash.

Reynolds Metals Co., one plant, 100,000,000 lb. at Lister, Ala.

Bohn Aluminum & Brass Co., one plant, 70,000,000 lb. at Los Angeles, Cal.

Olin Corp., one plant, 30,000,000 lb. at Tacoma, Wash.

# MEXICO

## U. S. Government to Buy Mexican Lead

**Conclusion of negotiations with Metals Reserves encourages the mining industry —Transportation facilities to be improved in central and northwestern Mexico**

Mining in Mexico showed some slight improvement, with regard to production and exports, by far the most of the latter to the United States, in midsummer. Labor troubles still persist—three major companies settled these difficulties at considerable cost—but they are somewhat less acute. The industry has hopes of improvement for base metals, particularly lead, as the deal between the Washington and the Mexican administrations for the purchase of up to 225,000 tons of Mexican and Canadian lead has been completed.

▶ Cia. Minera y Explotadora de El Amparo, S. A., Monte de San Nicolas, Guanajuato, James E. Howard, Apartado 19, Guadalajara, Jalisco, general manager, will be able to continue operating as a result of its 500 workers agreeing to accept a 10 percent weekly wage discount until the firm makes an economic recovery, the national miners union announced.

▶ Settlement of work disputes that involved three major mining enterprises and concerned the demands of the national miners' union for revision of contracts to provide higher wages and other economic concessions has been announced by the labor ministry. One of these disputes concerned Moctezuma Copper's unit at Pilares de Nacozari, Sonora. The ministry induced the union to cancel a strike threat against this unit. The workers pledged themselves not to demand a revision of the present contract before next Jan. 16, so that those interested may have ample time to arrange this pact peacefully.

▶ American Smelting definitely ended a long dispute at its Los Morales unit, San Luis Potosi, by paying the national union 126,000 pesos ($27,500) to cover wage increases for this year. This agreement was reached after a long series of conversations between representatives of the company and the workers in Mexico City and San Luis Potosi City. This conflict featured a "hunger march" on Mexico City by 150 of the unit's workers. They traveled the long distance afoot. This manifestation embarrassed the Federal

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## ▶MEXICO

Government and provoked indigation among many San Luis Potosi miners, who declared that it was absurd and unnecessary because this phase of the dispute—payment of indemnifications for victims of professional illnesses—could be arranged without appealing to any authorities, as the company was ready to make an equitable settlement.

▶Mining of a considerable sector of central and northwestern Mexico is to be benefited with regard to increased transportation facilities with the investment of 5,500,000 pesos ($1,300,000) the Federal and States governments have arranged for road building. Of this outlay, 3,000,000 pesos will be spent for a road through entire Baja California, from Tijuana to La Paz. The other investment, 2,500,000 pesos, is for the Durango-Chihuahua section of the central highway between Mexico City and Ciudad Juarez, opposite El Paso, Tex. Much work is to be done on both roads this year.

▶Financing for the iron industry is now available with the establishment in Mexico City by a group of Mexican capitalists of the Union de Credito de la Industria del Fierro, S. A. (Iron Industry Credit Union).

# CENTRAL AMERICA

## New Mill Begins Operations at Simon

**Several properties in Nicaragua increasing gold output—Airplane service adds greatly to steady development of mining industry**

### NICARAGUA

▶The 200-ton mill of the Empresa Minera de Nicaragua, at Limon, started initial operations in July. The company had planned to start work in May, but delays were experienced in delivery of electrical equipment.

▶Tailings from the old stamp mill near the Esmeralda mine, in Costa Rica, may be reground and the gold recovered by the cyanide process. Paul Rand, Managua, Nicaragua, is in charge.

▶At the San Juan mine, near La Libertad, a sand-leaching unit may be installed in addition to the present flotation plant. Airplanes of the Taca company have a landing field just outside La Libertade. About 10 miles northeast of La Libertade is the town of Santo Domingo, where the Javali mine is located. The gold ore from this property is treated in a 200-ton mill, where it is crushed by Holman stamps, ground in tube mills, and cyanided in counter-current decantation. Senor Calagaris, of Manana, Nicaragua, is the owner.

▶The San Gregorio mine, not far from

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LA PAZ, BOLIVIA SANTIAGO, CHILE
LIMA, PERU LONDON, ENGLAND

Santo Domingo, employing sand leaching and the slimes are treated by the old stir-and-decant method. Precipitation is by the Merrill-Crowe simultaneous clarification process. The plant is laid out, however, for changing over into counter-decantation by putting mechanical agitators in the smaller tanks and changing the sand-leaching tanks into thickeners that are placed for such conversion for the time when power is available for a tube mill to grind the coarse product from the stamps. Difficult terrain prevents airplane landing directing at San Gregorio. John Wiley is in charge of operations.

▶ Cia Mines Matagalpa, located about 85 miles from Managua, is now producing around 100 tons of gold ore that is milled in its plant, treating a fairly coarse grind in a counter-current system. Recovery of 94 percent of the gold is reported. C. Carlton Semple is general manager, Apartado 9, Matagalpa, Nicaragua. Supplies can be brought in by plane to within 10 miles of the property.

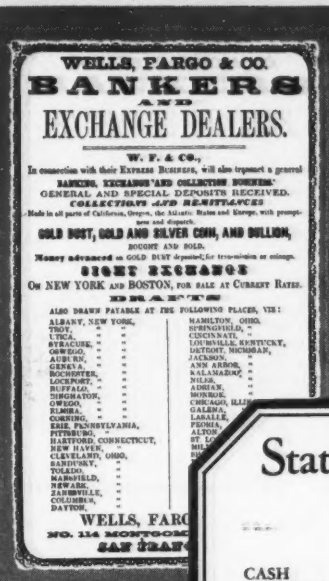
# SOUTH AMERICA

## Pan-American Congress of Mining Planned in Chile

**Chilean Institute of Mining Engineers invites mining men and geologists in Western Hemisphere to attend—Trips will include visits to large copper mines**

### CHILE

▶ Under the auspices of the Chilean Institute of Mining Engineers, the first Pan-American Congress of Mining Engineering and Geology will be held at Santiago, Chile, during the first two weeks of January, 1942. American and Canadian mining engineers and geologists are invited to attend. The purposes of the Congress are to demonstrate the progress achieved in mining and geology on the American Continent; to analyze and consider solutions of the more important problems in this part of the world in the fields of mining and geology; and to promote a closer friendship and a permanent interchange of opinions and ideas among mining engineers and geologists of the Americas. Papers will be presented on mining, geology, ore dressing, metallurgy, and mining legislation and economies of interest to mining in the Western Hemisphere. Trips will include the Braden Copper Co. mines at Rancagua, properties of Anaconda Copper, gold placers, the sulphur and nitrate mines, and some gold placers in Chile. The official languages of the meetings will be Spanish, English, and Portuguese. A large industrial and mining exhibit is also planned for the event. The executive committee is composed of the following members: Marin Rodriquez, president Chilean Institute of Mining Engineers; Roberto Muller, vice president; Osvaldo Vergara, Enrique Vial, and Tomas Vila, directors, and Americo Albala, secretary, with address at Calle Moneda 759, Santiago, Chile.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FIRST WELLS FARGO ADVERTISEMENT FROM SAN FRANCISCO DIRECTORY OF 1852

*Bankers to Western Business Since Gold Rush Days*

# Statement of Condition

*At the Close of Business June 30, 1941*

NOT INCLUDING TRUST FUNDS

| | | |
|---|---|---|
| ***Resources*** | | |
| CASH | | |
| On Hand and with Federal Reserve Bank | $47,268,502.77 | |
| With Other Banks | 22,141,289.40 | $69,409,792.17 |
| INVESTMENTS *(at not exceeding market value)* | | |
| United States Bonds and Notes | 187,544,478.01 | |
| Other Bonds | 24,397,680.16 | |
| State of California Warrants | 10,769,379.51 | 222,711,537.68* |
| Stocks and Other Securities (Including $450,000.00 Stock in Federal Reserve Bank of S. F.) | | 592,146.08 |
| LOANS | | |
| Loans and Discounts | 39,209,288.53 | |
| Loans on Real Estate | 8,296,793.04 | 47,506,081.57 |
| Customers' Liability for Credits and Acceptances | | 5,485,343.50 |
| Bank Premises, Furniture and Fixtures | | 3,009,614.31 |
| Other Real Estate Owned | | 587,539.35 |
| | | $349,302,054.66 |
| ***Liabilities*** | | |
| DEPOSITS | | |
| Demand Deposits | $191,399,698.52 | |
| Time Deposits (Savings and Commercial) | 120,683,339.52 | |
| Public Funds | 11,756,845.75 | $323,839,883.79 |
| Deposits to Secure Loans of Bonds to Customers | | 1,008,000.00 |
| Letters of Credit, Credits and Acceptances | | 5,830,648.57 |
| Reserved for Taxes | | 296,187.20 |
| Other Liabilities | | 404,139.75 |
| CAPITAL Paid in | 9,000,000.00 | |
| Surplus | 6,000,000.00 | |
| Undivided Profits | 2,923,195.35 | 17,923,195.35 |
| | | $349,302,054.66 |

*$16,768,130.76 *pledged to secure Public and Trust Funds;*
1,008,000.00 *bonds loaned to customers.*
$17,776,130.76

STATE OF CALIFORNIA } ss.:
City and County of San Francisco }

Frank B. King, Vice-President of Wells Fargo Bank & Union Trust Co., being duly sworn, says he has a personal knowledge of the matters contained in the foregoing report of condition and that every allegation, statement, matter and thing therein contained, is true to the best of his knowledge and belief. Frank B. King, Vice-President.

Subscribed and sworn to before me this 3rd day of July, 1941. Mrs. Emi Eggers Del Bono, Notary Public in and for the City and County of San Francisco, State of California.

*Correct* — Attest: Henry Rosenfeld, W. P. Fuller, Jr., Arthur D. King

DIRECTORS

| | | |
|---|---|---|
| Sidney M. Ehrman | I. W. Hellman | Wilson Meyer |
| James Flood | Arthur D. King | R. B. Motherwell |
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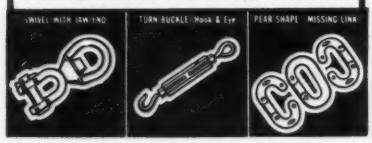
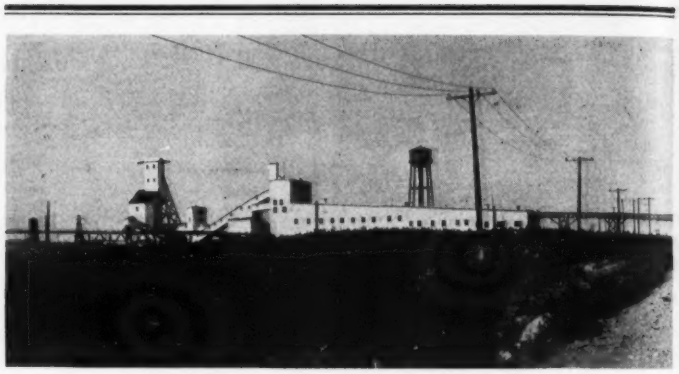






East Malartic Mines, one of Canada's major gold producers

# CANADA

## Noranda Mines Becomes Large Source of Pyrites

**Operations of sulphuric acid plant expected to start early in 1942—Hoyles Gold Mines is Ontario's newest gold producer**

### QUEBEC

▶ Noranda Mines is reported to be the source of large tonnages of pyrite to be processed by the new acid plant now under construction by the E. B. Eddy Co., replacing imported sulphur in making chemical pulp. The acid plant is to start operations early in 1942 and is expected to save a million dollars a year in United States exchange. It is believed similar steps will be taken by other paper manufacturers in Canada. Nicholls Engineering Co. is associated with Noranda in installing eight dryers, four already in use, for treating pyrite before shipping to acid plants. At Noranda's annual meeting last May, President James Y. Murdock stated: "It is expected that the utilization of pyritic ore will become increasingly important to your company and will be of benefit to the national balance of trade in that shipments will be made to the United States and some of the material will be treated to replace the importation of sulphur."

▶ Malartic Gold Fields, adjoining East Malartic Mines on the east, has met with considerable success in locating new ore since production was started in December, 1939. Diamond drilling in July in an area 2,200 ft. west of the main shaft located a 17-ft. vein just below the collar of the hole, followed by a 10-ft. intersection in a second hole 200 ft. deeper. A third hole, 100 ft. to the west, cut the vein for a width of 28 ft. Average grade in the first two holes was $16.17 a ton. Structural conditions give this discovery the appearance of importance, and exploratory drilling is being continued. The main shaft, at a depth of 1,350 ft., supplies production at more than $160,000 a month. Dr. Robert Halet is mine manager and James P. Norrie consultant.

▶ A second mill handling more than 1,000 tons a day will be in operation in the Malartic camp as soon as equipment has been delivered and installed at Canadian Malartic Gold Mines. Machinery on order for stepping production up from 800 tons to about 1,100 tons includes a ball mill, filter, classifier, trays, and thickeners. The proposed increase is scheduled for September, five years' ore supply being in sight, with reserves estimated at 1,704,500 tons at the end of 1940. The large boundary orebody is being prepared for stoping and the No. 2 shaft is being deepened to the ninth level. In the southeast section of the property the 708 orebody is being opened up. E. V. Neelands is general manager and J. P. Millenbach is mine superintendent.

### ONTARIO

▶ Ontario's newest producer, Hoyle Gold Mines, is at the northeast end of the Porcupine camp, adjoining Pamour. With ore reserves of 1,300,000 tons, the modern milling plant started operations at 600 tons a day. Grade averages 0.124 oz. per ton, with operating costs under $3.25. The ore zone has an average width of about 40 ft. Annual production is estimated at $1,000,000, which is about the cost of developing and equipping the mine. Financing was chiefly done by Ventures Limited and associates, through Thayer Lindsley, who is vice president of Hoyle. The mine staff includes J. M. Cunningham-Dunlop, manager; L. J. Lichty, mill superintendent; C. T. Penney, mine superintendent; and G. H. Mustard, engineer.

▶ Yama Gold Mines, 10 miles southeast of Kirkland Lake, in the Boston Creek area, plans to enter production by the end of August. Rated capacity is to be 75 to 100 tons daily, the construction being financed through the sale of short-term 6 percent notes amounting to $60,000. The mine installed electrical equipment last winter, following extensive diamond drilling and underground work from the 545-ft. shaft. Dr. Harold G. Way is mine manager and J. P. Nowlan is consulting geologist.

▶ Sturgeon River Gold Mines has been following an aggressive program of mine expansion since last winter, when im-

portant ore disclosures were made. The mine manager, H. Smedley, reports plans for deepening the main shaft another 500 ft. to open three new levels down to 2,250 ft.

▶ Serious bush fires destroyed part of the transmission line of Pickle Crow Gold Mines in June, causing a reduction of $17,400 in the normal mill rate. Otherwise, recovery has been in line with the first half of 1940, averaging $19.82 a ton. On the deepest level, at 2,200 ft., grade is higher than mine average. The new mine being developed on the north zone has been supplying ore averaging $14, the vein width averaging about 6 ft. Eldon E. Brown is mine manager and Jack Hammell president.

▶ New ore developments by the Golden Gate Mining Co., in the west section of Kirkland Lake, has resulted in increasing mill recovery for June to an average of $13 a ton. The new No. 35 vein has been proved on the 350, 475, and 600 levels. Increases in length and width give promise of good results down to the lowest horizon at 975 ft. Mine manager S. A. Pain points out the possibility of boosting mill capacity above the present 70-ton rate.

▶ Creditors of Morris Kirkland Gold Mines, in bankruptcy, have sanctioned plans for continuing production under trustee management while final efforts are made to find new ore on the lower levels.

## BRITISH COLUMBIA

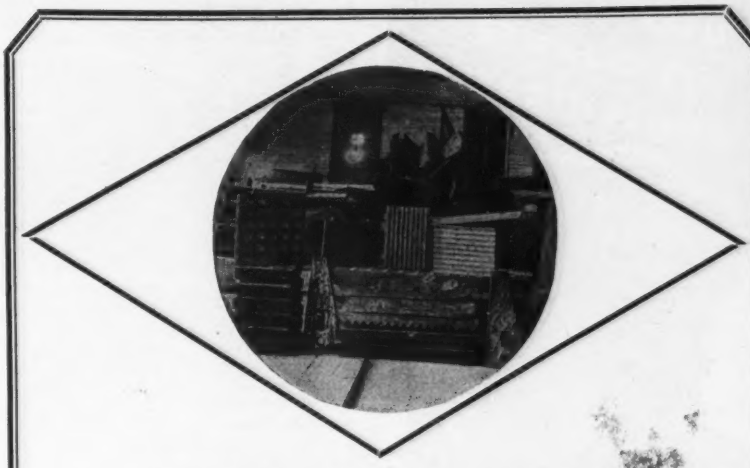
▶ During the last quarter, Privateer Mine, Ltd., leading Zeballos district producer, has deepened the shaft 125 ft. and opened the 1,300 level. Drifting has been done on the No. 1 and No. 2 veins on this level, and though the results have been encouraging, no orebody of commercial grade has, so far, been found.

▶ Central Zeballos Gold Mines, Ltd., has its low-level tunnel well advanced. A saving in operating costs by elimination of hoisting and tramming of ore is to be effected through this improvement.

▶ Hedley Mascot Gold Mines, Ltd., in the Similkameen district had closed operations at the Canty property.

▶ Gold Belt Mining Co., Ltd., in the Nelson district, had production valued at $50,095 from 4,817 tons in June. The ball-mill motors were crippled for ten days on July 3, when struck by lightning. Shareholders were advised at the annual meeting that the present dividend rate of 4c. per share would be continued. The amount paid in dividends is under the control of the Foreign Exchange Control Board, which, due to the large proportion of stock held in the United States, restricts dividends to the amount earned, after allowing for depreciation and depletion.

▶ B. C. Magnesium Co., Ltd., has been incorporated and plans to develop deposits of hydro-magnesite and rock magnesite in the Williams Lake and Clinton districts. The new company is private and fully financed, with the majority of its capital originating in California. H. C. Wilmot, now vice president of Bonanza Mines, a large mercury pro-

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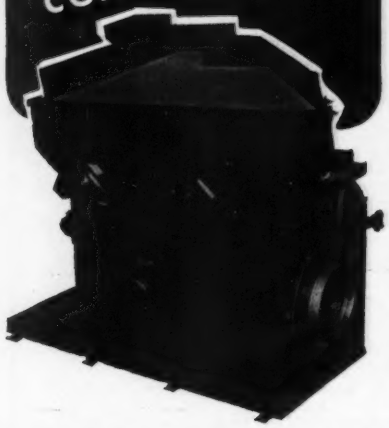

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1 Higher grade product, less loss than wet separation.

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S&S PROCESS

## ▶CANADA

ducer in southern Oregon, and formerly manager of the Lorne mine, in the Bridge River area, has been engaged as consulting engineer. A contract for a minimum of 2,000 ft. of diamond drilling has been let. The results of this program, together with the availability of power, will be the determining factor in the future development of the property.

▶Consolidated Mining & Smelting Co. of Canada, Ltd., has taken over the Red Rose property, on Rocher de Boule Mountain, near Hazelton. A site is being cleared for a mill and a right-of-way for a tram line is being cut. The mill will be erected as soon as possible. Red Rose ore consists of scheelite in a quartz gangue and is considered one of the outstanding tungsten deposits in British Columbia.

# AFRICA

## Chris Shaft to Have Large Air Cooling Plant

**This is second installation at the Robinson Deep mine**

▶The increasing depth at which mining operations are being conducted (most of the principal mines now working from 7,000 to 8,500 ft. below surface), and the consequent increase in the rock and air temperature, present a serious problem of the gold-mining industry in South Africa. To improve this condition air-cooling plants are being installed. It is calculated that with the present shaft system (mostly vertical downcast and upcast shafts), these plants will permit suitable conditions for stoping to 9,000 ft. Some in the industry believe that, on the basis of known temperature gradients on the Rand, it may be possible, with proper shafts, to mine below 12,000 ft. Six years ago an American firm, Carrier Corporation, Syracuse, N. Y., pioneered in this endeavor by erecting the first surface air-cooling plant in a South African gold mine. This plant, installed in the Turf shaft of the Robinson Deep mine, consists of three units of multi-stage compressors, with a total capacity of cooling effect equivalent to 2,100 tons of ice per day. During the years of operation the plant continually gave satisfactory results, and ventilation has improved to such an extent that stoping is taking place in depth which were previously unworkable. The Robinson Deep Mine of the New Consolidated Goldfields plans to erect another surface air-cooling plant at the Chris shaft in Johanesburg. The new plant, in addition to treating the ventilating air supplied through the Chris shaft, will

**Main shaft of the Geduld Proprietary Mines, Ltd. Development work consists chiefly of preparing large low-grade ore blocks for exploitation**

cool and devaporize the compressed-air supply. This plant will be the largest of its kind in the world and will be installed by Carrier Engineering, South Africa, Ltd. The two Carrier centrifugal refrigeration machines will have a cooling capacity equal to the melting of 4,000,000 lb. of ice daily. The present air-conditioning system at the Turf shaft has reduced the former temperature 27 deg. near the surface and 9 deg. at the bottom of the mine. The City Deep

**Milling 1,370,000 tons of ore in 1940, exceeding that of the previous year for the twelfth year in succession, the above plant of the Geduld Proprietary Mines, Ltd., in the Union of South Africa, yielded about 4.56 dwt. of gold per ton of ore.**

has decided too to install an air cooling plant at its No. 4 shaft to improve the working conditions. Its capacity will be 350,000 cu. ft. of air per minute. A cooling plant is planned at the No. 17 shaft of the Crown Mines to supply 450,000 cu.ft. of air per minute. It is estimated that the plant will reduce the wet-bulb temperature of the air from 62 deg. F. to 38 deg. F.

# AUSTRALIA

## Mica Deposits Being Exploited

**Output is not large, but areas in the Northern Territory, North Queensland, and Tasmania are being examined and prospected**

▶ Deposits of high-grade mica are being worked in the Northern Territory, and other occurrences of a promising nature have been examined recently in North Queensland. The localities are remote and the increased demand for mica is causing more intensive prospecting in favorable country nearer to transport routes and to centres at which mica is utilized. Government assistance is always available to prospectors to assist in the discovery or opening up of minerals of economic importance and the Tasmanian Mines Department is now assisting in testing a mica deposit near the old Zeehan silver field, on the West Coast. There are extensive areas of pegmatite in the district, which has been noted in the past for the production of silver, lead, and tin, with occurrences of nickel and osmiridium further out, which have been worked with varying success. The country is rough and difficult to prospect, and attention has hitherto been directed to metallic minerals.

## VICTORIA

▶ Victoria Gold Dredging, N. L., operating on the flats bordering the Loddon River at Newstead, has been working in ground below average value. During the last three weeks reported, the dredge dug 180,086 cu.yd. in 404 hr. and recovered 938 oz. of gold, an average of 2.5 gr. per cubic yard. The company has recently announced that a lease has been obtained covering the additional areas estimated to contain 2,500,000 cu.yd. with a value of 4 gr. gold per cubic yard.

## QUEENSLAND

▶ At the Golden Plateau Mine, at Cracow, west of Rockhampton, an extensive diamond-drilling program is being carried out. The last monthly return discloses the recovery of 1,824 oz. of gold from the treatment of 6,917 tons of ore, labor employed totaling 188 men. The mill capacity is 120 tons of ore per 24-hr. High-speed rolls are incorporated as secondary crushers.

▶ During April, Mt. Morgan, Ltd., mined

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**Reduction in Gauge Strengthens**
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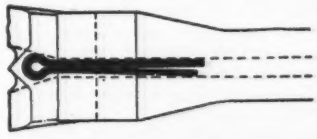

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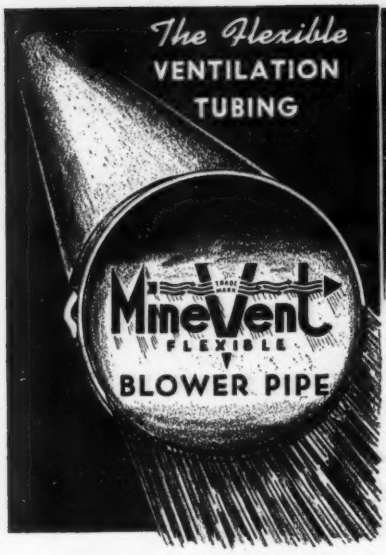


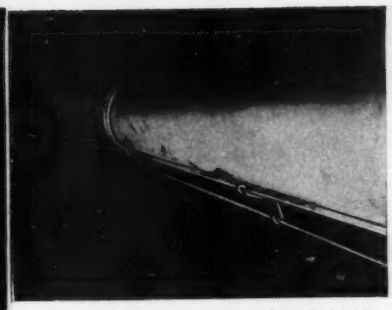

*Photo of "MineVent" in a Montana Gold Mine*

**. . . . SUPPLIES CONTINUOUS FLOW OF FRESH AIR TO UNDERGROUND WORKINGS . . . .**

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The important work of ventilation in metal mines can best be accomplished by installing this economical system—MINE-VENT Flexible Blower Pipe. An air-tight patented coupling permits quick installation of tubing by unskilled labor—tubing can be rotated in patented coupling to proper position or to relieve points of wear. It is light in weight, easily carried, quickly demountable. Can be bought by the foot and cut off to any length —no waste. Installation may be vertical, horizontal, turned round corners, or suspended out of working spaces. Four types of fabric make possible selection to suit any condition: (1) where development is in progress and light weight is desired (2) with conveyors where there is frequent moving (3) for ordinary mine conditions and continuous duty (4) for extreme conditions in deep mines. Send for important facts on this low-cost, practical method for auxiliary ventilation. Our many years of experience serving mine operators is at your disposal to help you work out a safe, dependable, economical ventilating system. We also carry a full line of tarpaulins, canvas, etc.—send for this information too.

***ABC Jute Brattice Cloth is specially treated to resist corrosive conditions and to reduce air friction — four grades from which to choose to properly fill your needs, give POSITIVE ASSURANCE against . . .***

**Flame** — ABC cloth has the benefit of much research and actual test in order to secure the best known flame resistant chemical treatment.

**Fungi** — The chemicals used in our treatment form a compound which will resist the many types of fungi found in some mines.

**Leakage** — Our high specifications mean a closely woven cloth from heavy Jute yarns, assuring you of working places well ventilated.

**Shrinkage** — Moisture found in many mines will not cause shrinkage of ABC Jute; therefore you are "playing safe" when using ABC Jute because no air can escape underneath the curtains.

*American* BRATTICE CLOTH CORPORATION
WARSAW, INDIANA
*Agencies in all Mining Centers*


## ▶AUSTRALIA

72,218 tons of sulphide ore and 6,179 tons of oxidized ore. The mills treated 71,450 tons of sulphides and 4,720 tons of oxides for an estimated production of 2,634 oz. of gold and 307 tons of copper. Men employed during the period numbered 995. Negotiations are proceeding between the company and the State government to secure a guarantee of a loan of £A110,000 for the purpose of establishing a copper refinery at the Mt. Morgan mine. It is estimated that the plant would produce 11,400 tons of copper annually and it is anticipated that with a refinery established in Queensland, associated industries for the manufacture of copper cables, sheeting, tubing, and alloys would be established.

## WESTERN AUSTRALIA

▶ It was announced in March that, following the settlement of litigation regarding the leases of Mount Charlotte (Kalgoorlie) Gold Mines, Ltd., at Kalgoorlie, development work was to be commenced under the control of Paringa Mining & Exploration Co., Ltd. It was also stated that a loan of £A30,000 had been granted by the State government for the erection of mining and treatment plant, the intention being to erect the milling plant adjacent to the Paringa company's mill to facilitate supervision.

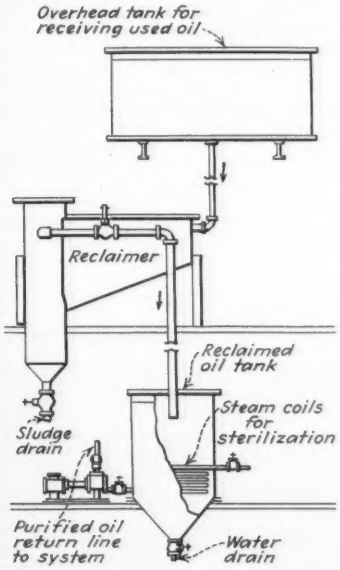
▶ The policy of erecting and operating State-owned batteries is followed in Western Australia, Northern Territory, Victoria, and South Australia and has assisted toward an important contribution to Australian gold output as well as to a material increase in the population of many mining fields. The object of the State battery is to provide facilities for the treatment of gold ores—and in a few instances, tin ore—won by prospectors, co-operative parties of miners, and small mine owners, who, in many cases, would be without means of realization on their output unless at a prohibitive charge for transport to the nearest operating mine. The State battery usually comprises 5 or 10 head of 1,000-lb. or 1,250-lb. stamps, frequently preceded by a rock-breaker, and gold is recovered by amalgamation. In Western Australia, Northern Territory, and South Australia, most State batteries include a cyanide plant for the treatment of sands, together with a proportion of slime by leaching, satisfactory results being obtained with a sun-dried slime content as high as 40 percent. The plants are driven by steam, producer gas, or crude oil, according to circumstances, and are managed by men experienced in the treatment of gold ores and who are usually competent assayers. A charge is made per ton of ore for crushing and amalgamation and is sufficient to cover cost: sands are bought on assay, less a fixed deduction for metallurgical loss. Owners of ore are usually present during the crushing and assist in the clean-up; they may also provide labor to feed the stamps if mechanical feeders are not installed.

# EQUIPMENT NEWS

## Oil Clarifier

GALE OIL SEPARATOR CO., Chrysler Bldg., New York, N. Y., announces an oil-reclaiming unit for use in industrial plants to remove dirt from oil used in combustion engines, electric motors, automatic tool machines, etc. This mixture of dirty oil is placed or pumped in a tank and the oil is guided by a direction baffle to the bottom of the reclaimer, which at the same time disperses it outwardly to the sides. Immediately, desludging or separating impulses are created so that the lighter oils rise to the surface. This inflowing current of oil comes in contact with a specially designed and engineered breaker wedge that further splits and separates this oil, thus accelerating the lighter oils upward and the sludges downwardly.

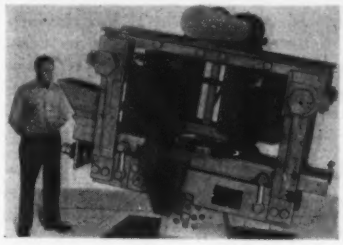
The heavy sludgy material is bounced, rolled, and scrubbed, which further




causes the breaking apart or separating of impurities from the oil. As the oil is released of the heavy sludges and other injurious material, it is said to rise to the surface and flows in a separate stream with the previously separated oils to the filter chamber. In this chamber is a specially designed filter unit, where the small atoms of carbon or silt are filtered from the oil and thereby clarified. The heavy sludge and other impurities are collected in a sump where they can be drained off and discarded.

## Magnetic Separator

MAGNETIC ENGINEERING & MFG. CO., Clifton, N. J., announces a newly designed magnetic separator and ore concentrator designated as Type VT, built in various sizes ranging from the laboratory machine having a carrying tray 4 in. wide, to the largest unit having a tray 24 in. wide. The unit illustrated is the 18 in. size. Material to be separated is loaded into the feeding hopper at the front of the machine. An adjustable gate is provided for regulating the



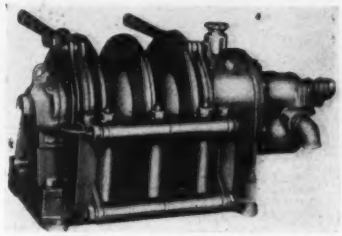
rate of feed. A tray, directly below the hopper, is actuated by eccentrics and shakes with a reciprocating motion. Material is carried down the tray under the suspended magnet poles, and the magnetic material is lifted to the poles. A non-magnetic disk is interposed between the magnet poles and the tray, and this disk carries the magnetic material off to the side of the separator. The non-magnetic material travels down the tray and is discharged at the end of the machine. The magnetic gap, the current flowing to the coils, the incline of the shaking tray and rate of feed, are all adjustable.

## Journal Bearings

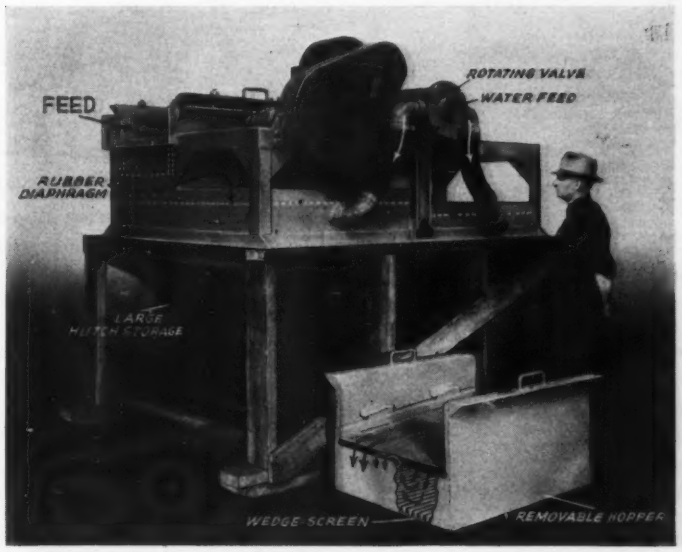
A NEW AND IMPROVED LINE OF solid and split journal bearings, carried in stock and neatly cased and labeled for prompt delivery, is announced by the Jeffrey Mfg. Co., Columbus, Ohio. Said to be of accurate dimensions with modern rounded lines and smooth gun-metal finish, these bearings have machined bases and faced ends. Height to center line of shaft is rigidly maintained. The babbitted bores are said to be broached to smooth hard surface and require no "wearing in." Both styles are tapped for grease cups or pressure fittings. An ample storage groove in the top provides proper distribution of lubricant.

## Portable Scraper-Hauler

SULLIVAN Machinery Co., Michigan City, Ind., announces its new, 250-lb. portable scraper-hauler which the company designates as the "Portage S-211." It is claimed that because of its light weight, the S-211 is the most portable two-drum hauler. Features listed by



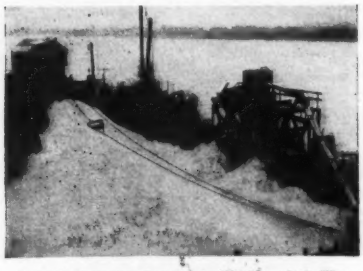
the manufacturer are: interchangeable electric or "Turbinair" motor, and the weight (less rope guides) is only 250 lb., with either motor. Other features are flange type "Turbinair" motor, planetary clutch gears, external contracting two-piece friction clutches,




**Wedge-Bar Screen Corp., 145 Hudson St., New York, N. Y., offers a new wedge bar screen for ore preparation. The screen has special bar profiles said to permit a minimum of blinding, and a maximum of capillary attraction in the continuous slot, for use in jigging, dewatering, filtering, and screening. The wedge bars are anchored firmly in U-holder slots with rivets passing through the U-holders. This method of assembly is said to offer rigidity and uniform support and carrying capacity, with maintenance of slot accuracy during use. One example of application is shown herewith in the Denver Equipment Co. mineral jig**

# Bulk Storage Simplified

Above is a typical example of a Sauerman Scraper installation of large capacity with self-propelled tail tower as used at mines and processing plants for open storage of materials. This type of machine is able to cover a wide storage area and handle a large tonnage both storing and reclaiming.



A small Sauerman Scraper stockpiles crushed silica rock on an irregular ground space alongside a washery and reclaims this stored material as required to a drying plant.

**with an economical**
**SAUERMAN SCRAPER**

**At mines, mills and smelters, Sauerman Power Scrapers are being used most effectively in the stockpiling of both raw and processed materials, either in the open or inside buildings.**

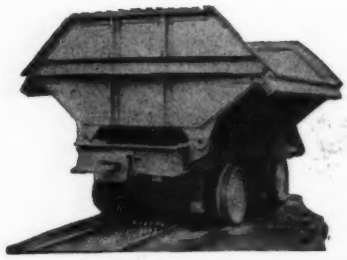
**One of the great advantages of this equipment is its flexibility, which permits Sauerman engineers to adapt each scraper installation to the exact needs of the job.**

**Moreover, the first cost of a Sauerman installation is reasonable, maintenance amounts to very little, and the simplicity of operation makes it possible to place the control of even the largest installation in the hands of one operator.**

*If you haven't the Sauerman Catalog in your files—send for it right away.*

**SAUERMAN BROS., Inc.**
484 S. CLINTON ST., CHICAGO, U.S.A.

# Speed Up Your Production with



KOPPEL

## INDUSTRIAL CARS

MODERN metal miners everywhere are using Koppel Cars to speed up and maintain uninterrupted production. All down the line—filling, hauling, dumping—Koppel cars are engineered for speed, dependability and long life. The quick, clean dumping action of the quarry cars illustrated insures full discharge of contents clear of rails or underframe.

Bulletin No. 71 briefly describes and illustrates over 75 types of Koppel Cars built to speed up production.

KOPPEL

**PRESSED STEEL CAR CO., INC.**
(KOPPEL DIVISION)
PITTSBURGH, PA.


toggle-type operating levers, alloy-steel gears, and sealed lubrication system. S-211 may be column mounted and is recommended for handling ore in square sets, mucking out short crosscuts, handling waste fill, and for all short jobs so frequently found throughout the mine.

The unit has a rope pull of 1,000 lb., with rope speed of 125 f.f.m.

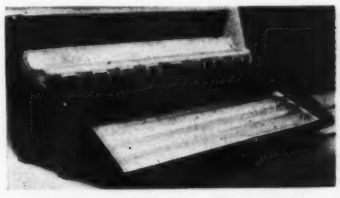
### New Semi-Magnetic Starters

DESIGNED especially for mining service to furnish low-cost means of starting and stopping, a new d.c., semi-magnetic motor starter is announced by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. For use on motors, driving pumps, and compressors, these 1- to 15-hp. starters are said to provide overload and circuit protection on 230-550-v. d.-c. lines. The starter consists of a sheet-steel inclosure containing one single-pole, 600-v., 60-amp., front-operated "quick make" and "quick break" De-ion line switch, a small ebony asbestos panel, an accelerating contactor, and a resistor.

In operating, when the switch is closed the motor is started with a resistor in series with the armature to limit the starting current. The accelerating contactor coil is connected across the motor armature. As the motor accelerates, the voltage across the armature increases and causes the accelerating contactor to close at the proper time, short circuiting the resistor and connecting the motor across the line.

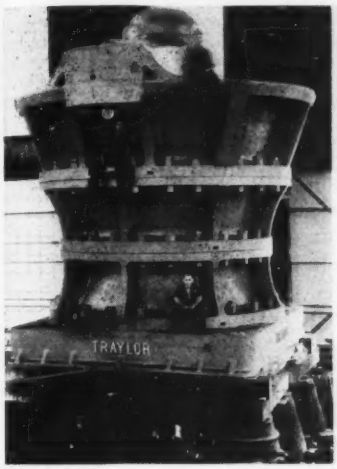
### New V-Belt

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., announces fundamental improvements in its V-Belt structure. All its Texrope V-Belts are now of the new "Super 7" laminated design, based on the Vogt formula and abundant field experience, to include more strength and flexibility, greater service, and longer life. The cords in the new "Super 7" belts are smaller, permitting the use of more cords per belt, with a resulting greater strength and less stretch. Each cord is said to be individually imbedded in heat-dissipating rubber to reduce internal belt degeneration. These belts are made in matched sets to assure uniform, smooth-running, highly efficient drives.



**Designed exclusively for recovering fine and flaky-gold, the manufacturer of the Thibault Gold Amalgamator, (shown above) 520 Divisadero St., San Francisco, Calif., also claims recovery of the heavy rare metals. No mechanical power is required for operation**

Large Gyratory Crusher




Considered to be the heaviest cast-steel gyratory built, weighing around 1,000,000 lb., this 60-in. Traylor Bulldog crusher built by the Traylor Engineering & Mfg. Co., Allentown, Pa., will be installed at the new mill of the Phelps Dodge Corporation, Morenci, Ariz., the initial capacity of which will be 25,000 tons of copper ore daily, with a possible future increase to 40,000 tons per day. The primary crusher will break about 1,600 tons of ore per hour. Crushing head and concave are of manganese steel and shafts ore of forged steel. An electric motor of 500 hp. is required for driving this unit


**Save your worn down or cracked MANGANESE STEEL PARTS— Conserve Steel for NATIONAL DEFENSE by WELDING with**

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**MANGANESE NICKEL STEEL**

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CAST WEDGE BARS

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NEWARK, NEW JERSEY



**Do You Get These 8 Advantages With YOUR Diamond Bits?**

1. Resharpen in 2 to 5 minutes, *on the job*
2. No reprocessing—No resetting
3. No diamond salvage worries
4. 90% diamond utilization
5. No diamond loss hazard
6. Reduced diamond inventory
7. Closer hole tolerance—no unnecessary reaming
8. Stands more abuse

Try SINTA-SET
Reg. U.S. Pat. Off.
CORE BITS

When you can drill up to 50% more footage per day—and reduce bit costs 74%—there must be a reason for such outstanding performance!

That's the experience of one mine using Sinta-Set Bits for drilling jasper, iron ore, and green rock. 27 feet drilled per day! 58c saved in bit cost per each foot drilled—compared to carbon diamond bits previously used!

If you haven't tried Sinta-Set Core Bits—introduced last Fall—by all means write for complete facts today. Results reported from users to date have been of an extremely high order in terms of reduced drilling and maintenance costs, lower over-all bit cost, and decreased drilling time.

A 5-minute sandblast operation resharpens Sinta-Set Bits. Compact, economical equipment available. See catalog No. M-100.

Section of Sinta-Set Bit. Diamonds not only on the surface but throughout special matrix. Each resharpening exposes new cutting surface.

CARBOLOY COMPANY, INC.
11193 E. 8 MILE ST. DETROIT, MICHIGAN

*Send for Catalog M-100*

*Sales Agents*

CAIRD ENGINEERING WORKS, HELENA, MONTANA

THE COLORADO IRON & EQUIPMENT COMPANY
1401 Osage Street, Denver, Colorado

E. J. LONGYEAR CO.
Foshay Tower
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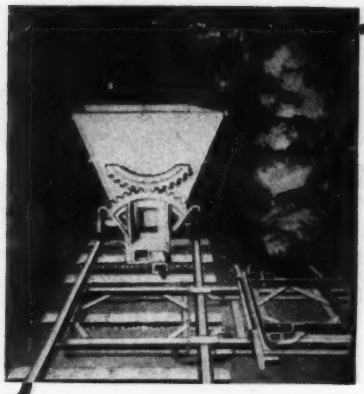
CARBOLOY SINTA-SET
Reg U S Pat Off
DIAMOND CORE BIT



*A step towards modernization*

●

**NEW NARROW GAGE MINE CAR TRANSFER**

●

● Great strides have been made in the transporting of ore underground since the early days and one of the recent improvements is the Canton Transfer for track gauges of 18 in. up to 24 in. with a rail minimum of 16 lbs., handling cars up to 3500 lbs. This transfer enables a loaded train of cars to pass empty cars, one by one, on a single track.

No slabbing is required in large tunnels and very little in smaller ones as successful operations are easily achieved with a minimum of space available for attachment to track. Installing or detaching for moving can be handled by two men in two minutes.

The Canton Transfer presents numerous advantages such as single track for loading or dumping, elimination of short cross cuts for car space, switches and additional track. Following the mucker right up to the face, the Transfer advances with the work.

Investigate the Canton Mine Car Transfer for lower cost loading and dumping. Complete details upon request. Write—

**AMERICAN MINE DOOR CO.**

2055 DUEBER AVE., CANTON, OHIO



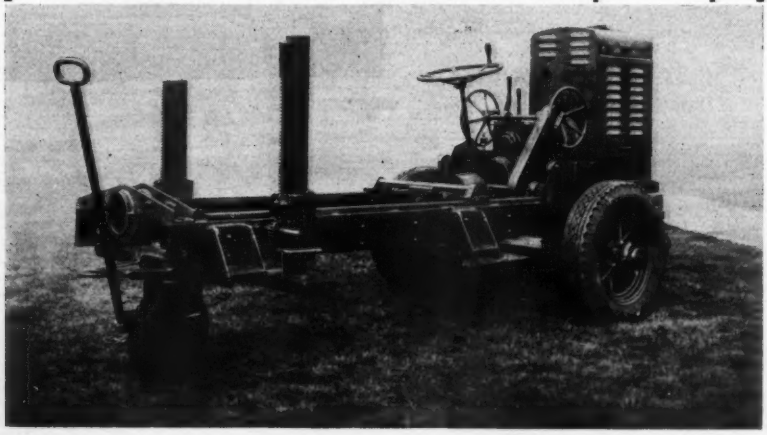
**PARMANCO** → **HORIZONTAL DRILLING MACHINES**

*Made good in* **IRON RANGE** *and Coal Fields*

Drill up to 6" holes, 60 feet in depth this simple, easy way. Just pull one pin to remove front wheel and the PARMANCO is ready to begin work. Operators have the drilling speed always under control so that drilling steel is not damaged. Clean holes always drilled. The augers have special drill heads for tough wear—they really stand up under unusual conditions and you are assured of longer wear. Write for full details.

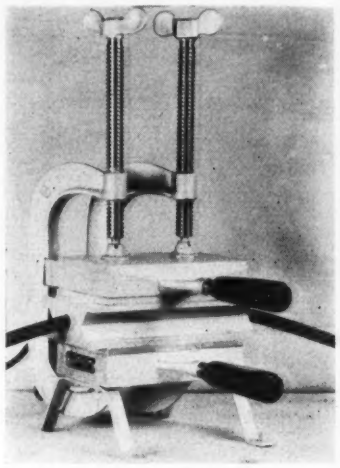
**PARIS MANUFACTURING CO., PARIS, ILL.**

• Only 15 seconds to disconnect the drill and hitch up the motor for traction on wheels to move to any location.




## Cable and Belt Vulcanizer

BECAUSE of the growing shortage of copper, repairing of rubber-covered electrical cables is becoming more common; and for this work the Shaler Company, of Waupun, Wis., maker of tire-vulcanizing equipment, has improved its industrial vulcanizers for use in replacing



rubber insulation covering where cables are spliced or where insulation has become damaged. Interchangeable mold blocks to accommodate various size cables are provided. Other models are made for splicing round or flat rubber belts (up to 5 in.)—all being electrically heated and furnished with appropriate attaching cord and plug for connection to ordinary 110-120-v. electrical circuits.

## First-Aid Cabinet

A NEW MINER'S FIRST AID CABINET, manufactured by the Mine Safety Appliances Co., Pittsburgh, Pa., is said to provide a complete assortment of first-aid materials for the mine emergency hospital and dressing station. The materials included in this new cabinet are the complete, revised list specified in the (1940 Edition) Manual of First-Aid Instructions, published by the U. S. Bureau of Mines. First-aid materials contained in the kit include triangular and compress bandages, adhesive compresses, sterile gauze, picric acid gauze, ammonia ampoules and inhalants, tourniquots, paper cups, bandage scissors, splinter forceps, splints and the Manual of First-Aid Instructions. Bandages and ampoule products are put up in handy individual packages, plainly marked and easily removed.

The steel case of the cabinet is equipped with two snap locks, brackets for hanging, and double carrying handle.

## Electric Silver Solder Brazing Unit

A NEW ELECTRIC BRAZER for brazing and soldering with silver solder is announced by the Ideal Commutator Dresser Co., 5102 Park Ave., Sycamore, Ill. This consists of a power unit or transformer and a pair of electric heating pliers. Holding the part to be

brazed in the pliers, closes the secondary circuit, causing the part to heat to brazing temperature quickly. Heat is accurately controlled by on-off foot switch.

The Brazer is said to be compact, portable, easy to use and operates on 230-v., 50- to 60-cycle power supply. Also available are 440-v. and 25-cycle units. Rating is 7½ Kva. Secondary voltage is reduced to only 10 v. Heating pliers have 6¼-in. long throat. Face of carbon is 1¾ x 2-in. but may be filed to shape best suited for a particular job.

## BULLETINS

**Mucking Machine.** The Eimco Corp., Salt Lake City, Utah. Bulletin 106 describes and illustrates the manufacturer's new Model 40 Tunneloader for use in driving large tunnels. Pp. 4.

**Jaw Crushers.** Alloy Steel & Metals Co., 1862 East 55th St., Los Angeles, Calif. Bulletin 114 describes and illustrates the manufacturer's line of jaw crushers. Specifications and drawings are also included. Pp. 12.

**Placer Machine.** Universal Dredge Mfg. Co., Denver, Colo. Company has issued two leaflets, one illustrating and describing its Universal semi-crawler mounted Drybank placer machine. The other leaflet describes the manufacturer's dragline fed floating type placer dredge.

**Magnetic Variable Speed Drives.** Electric Machinery Mfg. Co., Minneapolis, Minn. Bulletin 1039 presents the principal characteristics, advantages, and constructural forms of the manufacturer's magnetic variable-speed drives. Pp. 12.

**Portable Generating Plants.** Bardco Mfg. & Sales Co., Los Angeles, Calif. Form B-530 describes the manufacturer's portable air-cooled generating plants for a.c. or d.c. use. Pp. 4.

**Auxiliary Ventilation.** E. I. du Pont de Nemours & Co., Fairfield, Conn. The company has issued an attractice brochure entitled "The Ventube System of Auxiliary Ventilation." The bulletin is well illustrated, showing applications for metal mines and tunnel construction. Pp. 43.

**Portable Crushers.** Smith Engineering Works, Milwaukee. Catalog 265-C describes the manufacturer's portable crushers and catalog 261-M covers its line of primary breakers and crushers.

**Protective Insoles.** E. D. Bullard Co., 275 Eighth St., San Francisco, Calif. Leaflet describes the manufacturer's protective insoles for use inside boots or shoes. Pp. 1.

**Troughing Idlers.** Link-Belt Co., 307 N. Michigan Ave., Chicago. Folder 1793 describes and illustrates features of the company's new rubber tread impact troughing idler. Pp. 4.

**Flexible Couplings.** The Falk Corp., 3001 West Canal St., Milwaukee, Wis. Bulletin 8100 describes and illustrates features of the manufacturer's five types of Airflex Couplings. Pp. 18.

**Track-Type Loading Machine.** Goodman Mfg. Co., Halsted St., at 48, Chicago, Ill. Bulletin L-403 describes and illustrates manufacturer's hydraulic or mechanical controlled loading machines for underground use. Pp. 7.

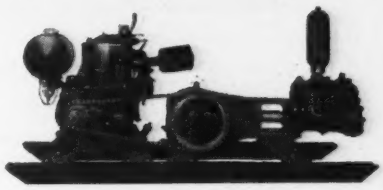
**Elevator Buckets.** Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill. Folder 1912 describes and illustrates the manufacturer's Promal elevator buckets of malleable iron. Pp. 4.

**Mending Cement.** Smooth-On Mfg. Co., 568-574 Communipaw Ave., Jersey City, N. J. Dept. 177. Small handbook describes use of Smooth-On cements for motor car, factory, or power plant and other industrial use. Pp. 4. The company also has a leaflet describing application of Smooth-On for concrete walls and floors. Pp. 4.

**Trammer Locomotive.** General Electric Co., Schenectady, N. Y. GEA-2354A describes and illustrates the manufacturer's 1½-ton storage-battery locomotives for use in metal mines. **Heating Cable.** GEA 3539 describes a flexible lead-covered cable to fit any low-temperature heating job involving temperatures of 165 deg. F. or below, to prevent pipe freezing, etc. Pp. 4. **How to Start and Protect a Synchronous Motor GES-2677.** Pp. 4.


**Get High-Pressure Low-Volume And Low-Pressure High-Volume**

**WITH BOYLES BROS. MODEL 5-12 DUAL CAPACITY POWER PUMP**



You have a choice of 500 Imperial G.P.H. at 250 lbs. pressure per sq. in. or 1200 Imperial G.P.H. at 100 lbs. pressure per sq. in. by simply changing water pistons and liners. This dual capacity feature is the result of many years actual field experience. You who are familiar with diamond drilling will quickly appreciate the advantage of the quick capacity change. It's self-oiling, sturdy and light in weight, too.

*Write for bulletin. Prompt attention to enquiries whether for sales or contract.*

**BOYLES BROS. DRILLING CO. LTD.**

**Diamond Drilling Contractors and Manufacturers**

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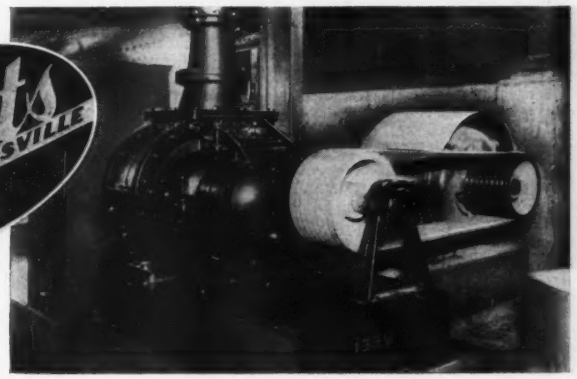

1200 CFM, 10½ lb. blower used for agitation in Canadian gold mine.

**Air FOR AGITATION**

Wherever air is used in ore refining, whether for flotation machines, smelters or converters, Roots-Connersville have a suitable blower that will help reduce operating cost. As builders of both positive displacement and centrifugal type blowers, we are in position to recommend equipment best suited for your requirements, based on our 87 years of experience in developing air handling equipment.

IN HANDLING AIR AND GAS Experience Counts

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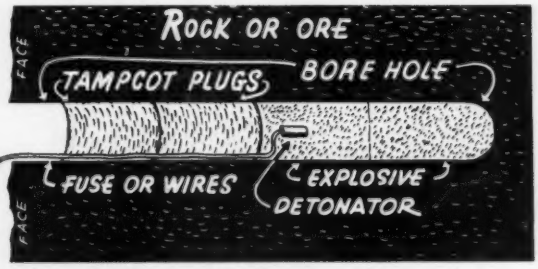


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**Crushers.** Smith Engineering Works, Milwaukee, Wis. Booklet illustrates and describes installation of primary breakers and reduction crushers and gives sizes and specifications of manufacture. Pp. 15. **Portable Crushers.** Booklet describes the company's line of portable crushing plants. Pp. 19.

**Pumps.** Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin B-6146 is a comprehensive booklet describing the manufacturer's line of single-stage double-suction centrifugal pumps. Pump engineering data and tables are included. Pp. 40. **Induction Motors,** Bulletin B-6132 shows the manufacturer's latest induction motor construction for bracket and pedestal types of 250 hp. and larger, and chart of each type. Tables contain general characteristics and curves show power-factor variations. Pp. 3. **Air Blast Breaker.** Leaflet A1230 describes features of the manufacturer's air blast breaker T.

**Slackline Cableway Excavators.** Sauerman Bros. Inc., 484 S. Clinton St., Chicago, Ill. Catalog 19, Sec. C, describes and illustrates the manufacturer's line of slackline cableway excavators for mining and other industrial uses. Pp. 24.

**Steel Pipe.** General Paint Corp., Hill, Hubbell & Co. Div., Cleveland, Ohio. Folder describes a process of coating and wrapping steel pipe. The company also has issued a leaflet on its "Shatterproof" mains. Pp. 1.

**Copper and Copper Alloys.** Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y. The company has issued three well-illustrated and informative booklets about its copper and copper alloys for use in the mechanical industries, process industries, and power plants, containing 43, 23, and 15 pages respectively.

**Builders' Plastic.** Rogear Company, 11 Water St., New York, N. Y. Leaflet describes application of the company's builders' plastic applied by brush, spray gun, or trowel. Pp. 1.

**Fuse Cutouts.** Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Dept. 7-N-20. Leaflet 38-620 describes and illustrates the manufacturer's primary fuse cutouts for outdoor use on distribution transformer installations. Pp. 4. **Fuse Links.** Leaflet 38-665 describes fuse links with ratings from 1 to 100 amperes. Pp. 8. **Unitized Switchgear.** Bulletin B-2273 describes features and operating details of light duty metal-clad switchgear for control stations and industrial plants. Pp. 24.

**Steels.** Hadfields, Ltd., Sheffield, England. Catalog 438 describes steels of high creep strength by the manufacturer for use at temperatures up to 550 deg. C. Pp. 14.

**Distribution Box.** Ohio Brass Co., Mansfield, Ohio. Bulletin 739-M describes and illustrates the company's Type GM permissible multiple distribution box. Pp. 4. **Motor Starter.** Bulletin 733 M describes and illustrates the manufacturer's line of Type ADG automatic d.c. motor starters. Pp. 4.

**Flotation Cell.** Denver Equipment Co., 1400 17th St., Denver, Colo. Bulletin F12-B describes and illustrates the manufacturer's unit flotation cell. Pp. 6.

**Pumps.** Peerless Pump Co., 301 W. Ave. 26, Los Angeles, Calif. Bulletin M8 describes and illustrates features of the company's hydrofoil propeller type pumps. Pp. 7.

**Compressors.** Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin S-550-B19 describes and illustrates the manufacturer's angle engine compressors. **Pumps.** Bulletin W-412-B30 describes and illustrates three types of horizontal duplex plunger power pumps. Pp. 6. **Centrifugal Pumps.** Bulletin W-304-B2 describes the manufacturer's line of two-stage volute Type U centrifugal pumps. Pp. 4. **Rotary Pumps.** Bulletin W-483-B1 describes the company's rotary pumps with double-helical gears. Pp. 11.

**Stretcher Outfit.** Mine Safety Appliances Co., Pittsburgh, Pa. Bulletin FA-74 describes the company's new stretcher outfit. Pp. 1.

**Refractory Brick.** General Refractories Co., Philadelphia, Pa. Bulletin describes features of manufacturer's Acido brick and different types of tower packing. Pp. 11.

**Crushers.** Traylor Engineering & Mfg. Co., Allentown, Pa. Bulletin 3112 describes and illustrates features of the various sizes of the manufacturer's Type